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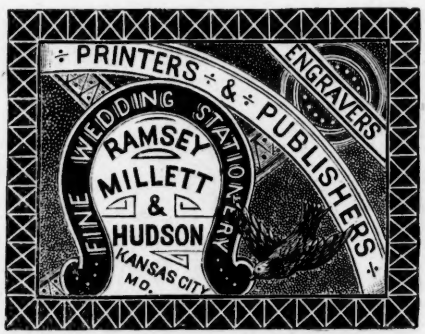

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REVIEW OF SCIENCE AND INDUSTRY,

A MONTHLY RECORD OF PROGRESS IN

SCIENCE, MECHANIC ARTS AND LITERATURE.

VOL. VIII. MAY, 1884. NO. 1.

BOTANY.

FUNGI—THEIR NATURE AND HABITS.

REV. L. J. TEMPLIN.

The most casual observation of the objects that surround us reveals the fact that they consist of innumerable and greatly varied forms of organic beings. A little scrutiny shows that these all belong to one or the other of two great kingdoms—the Animal and the Vegetable. These, in their higher forms, are distinguished by such marked characteristics that they cannot be mistaken; but in their lower forms they approach each other so closely that the unprofessional observer is often at fault, and even scientists and specialists sometimes engage in grave controversies as to which kingdom an individual, or species, should be assigned. But careful and persistent investigation always succeeds in clearing up all mysteries and removing all doubts as to the place any organic being should occupy in the established system of classification. Confining our attention to vegetable organisms we find two grand series, distinguished, especially, by different modes of fructification and reproduction. These series are the phanerogamous, or flowering plants, and the cryptogamous—flowerless, or spore-bearing plants.

As between the animal and vegetable kingdoms we find the line of demarkation but dimly drawn, so we find these two series of plants so nearly approaching in some of their forms that a knowledge of their natural history is essential to enable one to readily assign them to the series to which they belong. Some

ferns and equisetæ are readily mistaken for flowering plants, while, on the other hand, some Belanophoria closely simulate some of the fungi. But even a limited knowledge of botany will enable the student to avoid such mistakes. Cryptogams are arranged in a number of different groups, of only one of which—fungi—we wish to take notice in this paper. This group, Cryptogams, are essentially different from phanerogams, or flowering plants, not only in their different modes of fructification, but also in the very principles of their organic life. Phanerogams grow by the building up of their organic structure directly from the inorganic elements under the action of the life principle, which here operates as a constructive force. But fungi grow by the appropriation and assimilation of matter that has previously been organized by some of the higher organic forms, except, perhaps, in a few isolated cases of meteoric fungi, that derive all their nutriment from the atmosphere. Common flowering plants absorb carbonic acid from the air by their leaves and green twigs, and by some vegetable chemistry the constituents of this gas are separated and the carbon is appropriated to building up the organic structure of the plant, while the oxygen is exhaled again to the atmosphere.

This process takes place only under the influence of sunlight, and by this means chlorophyl—leaf green—which is the chief agent in building up vegetable tissues, is organized. But in the growth of fungi the very reverse of this process takes place. The growing fungus derives its nutriment from matter already organized, consequently it inhales oxygen and exhales carbonic acid, just as green plants do in the dark; so no true chlorophyl is formed by this class of plants. To all fungi belong both a vegetative and a reproductive system; but there is a great difference in the comparative development of these respective parts. In some, the vegetative, and in others the reproductive organs predominate; but in some forms the reproductive system appears to be entirely wanting. In such cases it is probable that the sporeless forms are but one stage in the development of some fungus that in some other stage and under some different form will become spore-bearing.

It is a fact that is now fully established and generally known that many fungi assume such different forms and exhibit such different phenomena at different periods in their history as to be recognized as different plants, and in many cases to receive different names and be classed in different genera, orders and even families. There are anomalous cases of fructification in which there is a succession of spores produced one from another, each generation growing smaller in size, sometimes to the fourth or fifth generation, the last one entering into the proper nidus and reproducing the original form. This continued reduction in size seems to be for the purpose of reducing the spores to such dimensions as will enable them to enter the stomata of leaves, or other suitable nidus, where conditions are suitable for germination and growth. An illustrative example of this mode of fructification is found in the entophytes of the order Cæomacei, which produce spores either single or in chains at the end of fertile threads, which

grow from a delicate mycelium. When these germinate they produce others, and so on to the fifth generation in some cases.

The Bean rust—Puccinia Fabæ—has, besides male organs, four different kinds of reproductive organs, only one of which reproduces the original form, while all the others have undoubted alternation of generation. First, the puccinia appears from the spores of which the Æcidium is produced and this is followed in the regular course of generation by Uredo, the spores of which enter the leaves of the bean and are developed into the Puccinia, thus completing the cycle of transformations.

It has been shown by Professor Henslow that Uredo linearis is only a secondary form of Puccinia graminis, thus proving that rust is but an earlier form of mildew. It is also a question whether Uredo segetum and Uredo mayidis, the smut of wheat and corn, are not only incomplete forms of other fungi. The natural history of Puccinia graminis is a very interesting one. For a long time farmers had believed that there was some mysterious relation between the Barberry rust, Æcidium herberidis, and the Puccinia graminis, or wheat rust. This was sneered at by those claiming superior wisdom, as a superstition similar to the once popular notion that the moon exerted a controlling influence over terrestrial vegetation. But late investigations by men of eminence as naturalists, and of superior ability as investigators, have proved this theory to be correct. It has been observed that cereals growing in the vicinity of barberry bushes affected with the Æcidium, became affected with rust as soon as the Æcidium had completed its fructification and shed its spores. That the bushes were the origin of the Puccinia in the wheat was rendered probable by the fact that the prevalence of the disease in the grain is seen to be in exact proportion to the contiguity of this to the diseased bushes—the disease being largely developed in the grain growing near the bushes but diminishing on receding from them, till at a considerable distance it disappears altogether. But we are not left to inference in this matter even from such positive premises, for M. DeBarry proved by direct experiment that the Puccinia could be transplanted to the leaves of the Barberry, where it produced the Æcidium, the spores of which when transferred to some member of the family Gramineæ, again produces the Puccinia. That this is a very usual mode of transformation in these two forms of fungi, is established beyond question; but that this is the only method of procedure, as recently asserted by an Indiana professor is evidently not correct, for it has been proven that the spores of the Puccinia may germinate directly on plants of the grass family.

On any other hypothesis it would be impossible to account for the sudden appearance of the wheat rust over wide regions of country, destroying the growing wheat by thousands of acres, as has been observed by the writer, where there was probably not a Barberry bush, on an average, to each township. Some other means must have been employed for the propagation and dissemination of these multitudinous reproductive germs to cause such wide-spread devastation of the growing grain as has, at times, been witnessed in some parts of the country.

Another instance of polymorphism in fungi is found in a species of Isaria, that is parasitic on the Bramble moth—Bombix Rubi—which has several distinct periods and modes of fructification. This fungus in passing from one stage of its growth to another, not only changes from one species and genus to another, but it actually leaps over the chasm that separates one family from another—starting as a member of Hyphomycetes and ending as a member of the Ascomycetes family. Numerous other cases are now known and many others are suspected in which fungi that have been named and classed as entirely distinct plants are but different forms of the same species. So far as we yet know these different forms are but steps in regular cycles that invariably return to the original starting point whence again to start on their regular round of transformations.

Our present knowledge does not warrant the conclusion that any of these changes are the progressive steps from lower to higher forms of vegetable organisms. The classification of fungi is based on the mode of fructification. According to this all fungi are embraced in two grand divisions or sections, accordingly as the reproductive germs are produced in cysts or capsules, or without any such enclosing organs. In this last the reproductive germs, called spores, are produced on spicules. This section has been called Sporifera from these facts. The other division is termed Sporidifera, in which the fruiting germs are produced in cells or cysts, and are termed Sporidia. To the first of these sections belong four families, two of which are furnished with a hymenium or spore-bearing surface, while the other two are destitute of this. Of the hymeniferous families one—the Hymenomycetes—has its hymenium on an exposed surface. Of this family the common mushroom—Agaricus—with its expanded pileus and radiating gills, is a familiar example. In the second family—Gasteromycetes—though a hymenium is present, it generally remains inclosed in a peridium, or outer investing membrane, till the spores are nearly or quite mature, when, by the rupture of the peridium, the spores are liberated and discharged into the air as fine dust. The common Puff-ball (Lycoperdon,) of the meadow is a well-known example of this mode of fructification. Of the two families, belonging to sporifera, that are destitute of a hymenium, the first to be noticed is the Coniomycetes, which is noted for the abundant development, in its advanced stages, of dusty spores. So great is the predominance of the reproductive system of fungi belonging to this family that at maturity nearly the whole substance of the plant seems to be converted into these spores. In the Hyphomycetes, the second family of this division, it is the spore-bearing threads or filaments that are the most noticeable for their abundance.

To this family belong that numerous class of low forms of fungi known as moulds. To these two families belong some of the most injurious species with which we are acquainted. In the first one we find that series of parasitic fungi that prove so deleterious to living plants, the Puccinia, Uredo and Æcidium. To these belong the various rusts and smuts of our grain fields.

To the second of these families belong the Mucedines, a single genus of which, the Peronospora, has proved the most destructive to living plants of any

of the parasitic fungi of any family. Here also we find the grape-vine Oidiums that have caused such havoc in the vineyards of both Europe and America. The very common moulds, Penicillium and Aspergillus, are also members of this family.

Of the Sporidifera section of fungi there are two families, the Physomycetes and Ascomycetes. In the first of these the reproductive cells termed sporidia are produced in bladder-like cells scattered on free or slightly felted fertile threads that proceed from the mycelium. The most noted order of this family is that of the Mucors in which asci with spore cells are produced in vascular sacs growing at the extremity of slender threads that spring from the mycelium or spawn. One species, the Ascophora elegans, is remarkable for having two kinds of fruit and for growing on bread while yet hot from the oven. To the Ascomycetes belong several orders of importance, among which may be mentioned the Perisporiacei, which are very destructive parasitic fungi. The mildews that infest and prove so destructive to the hop, rose, and peas, are found in this order. These form a coating of felt on the surface of the leaves that give them a white color. The Tuberacei are subterranean species, of which the Truffle is the most important. This is a highly prized article of food in many parts of Europe, and, I believe, in some of the southern parts of the United States. The Morchella furnishes a number of species that are highly esteemed as articles of diet. The number of different kinds of fungi is somewhat remarkable; more than two thousand of the more conspicuous ones have been figured. The order Agaracini contains not less than one thousand different forms, and some others are nearly, if not quite, as numerous in their genera and species.

If we direct our inquiries to the habitats of fungi we are confronted by the fact that from the frozen Steppes of the north to the burning plains of the torrid zone there is no climate, continent nor island where they are not found—on the open plains; in the deep, dark forests; on the bleak, barren mountains, and in the dark caverns; growing in the earth, on the rocks, attached to trees, logs, stumps, sticks, plants, leaves, offal, and in liquids; sending their mycelia into the stomata of leaves and the pores of timber; flourishing on all kinds of dead and decaying organic matter; and preying on all forms of living organisms, animal and vegetable; removing that which is already dead, and bringing disease and death to the living. Abounding in all latitudes, penetrating every orifice and crevice, thriving in all conditions, multiplying with a rapidity that is inconceivable, appearing at times in numbers that overwhelm the imagination, filling the air with their spores and sporidia, which by their levity are liable to be carried by the wind and sown upon all objects, where they patiently wait for the coming of conditions favorable for their germination and growth. Affecting the interests of all living beings, they command the attention and invite the study and investigation of all thoughtful students of nature. It therefore becomes a subject of interest to inquire in what manner and to what extent fungi affect other organic beings. One of the most important offices performed by this low class of organisms is to remove dead and decaying organic matter. Much of this mat-

ter, if left to decay in the air, would pollute the atmosphere with its poisonous exhalations. No sooner has life become extinct in any organic forms than they are seized upon as the nidus for innumerable forms of parasitic fungi, the spores of which have been so profusely sown upon every object, that penetrate their tissues and appropriate their substance to the building up of their own structures. In thus removing useless and offensive matter that would prove deleterious to health, these fungi prove beneficial. But some of them attack and destroy the texture of sound timbers to the great damage of buildings and structures. As, for instance, that one known as dry rot—Merulius lachrymans—that attacks the sound timbers of buildings, etc., sending its mycelium into the pores of the wood and reducing the inner portions to a rotten, worthless condition. Another similar one is Polyporus hybridus, which attacks oak-built vessels and causes much damage to them. But it is those parasitic fungi that prey upon living plants and animals that cause the most serious losses and are to be the most dreaded.

We need allude to but few of these parasites on living beings to illustrate the destructive power of these cryptogamic forms. The potato fungus—Peronospora infestans—has attracted more attention and caused greater ravages, probably, than any other parasitic plant in modern times. This has caused losses to the extent of hundreds, if not thousands, of millions of dollars since it first began its extensive ravages some forty years ago. The ravages of Puccinia on the cereals and of Uredo on maize, with their extensive damages, are too well and generally known to need extended elucidation.

The hop mildew has been the cause of extensive losses to that crop in those regions where it is extensively cultivated. The rose, verbena, hollyhock, gooseberry, bean, and indeed nearly every species of plant, are subject to the attacks of one or more species of cryptogamic parasites.

The rot in the apple, the blight in the pear, and the yellows in the peach are traceable to a similar cause. Were it not for the power of these low organisms, in connection with predatory insects, to hold in check the luxuriance of vegetable life, it is probable there would be such an exuberance of these forms as to literally overrun the earth. But if in this light, fungi are to be regarded as beneficial, it must be admitted that in many instances, as noted above, the matter is largely overdone—we have entirely too much of a good thing. But the attacks of fungi on living organisms are not confined to the vegetable world. Animals also are subject to these attacks. There no longer remains any doubt that many diseases are caused by the presence of fungi in the animal system. The White grub, the larva of Lachnosterna, is attacked by a species of fungus, probably a Sphærea, that grows in the form of sprouts from the sides of the mouth of the insect.

The disease among bees, known as "foul brood," is caused by a fungus that spreads over the surface of the comb and sends its mycelium into the young larvæ, soon reducing them to a putrid, stinking mass. The silk-worm disease that has proved such a scourge to the silk interest in France, is caused by the fungus Botrytis bassiana, that seems to defy all efforts for its extermination. The

common house-fly, Musca domestica, is subject to a species of fungus now called Sporendonema muscæ, that kills its victim and afterwards appears as a mouldy halo around it. The Bramble moth, Bambyx rubi, is attacked and killed by a species of Isaria. Different genera of this sub-order are found on dead larvæ of moths, dead spiders, etc., but whether they are the cause or consequence of death in these cases is doubtful. Some members of the wasp family—Vespa—are subject to the attacks of the fungus, Torrubia sphenococephala, which may be often seen protruding from the insect while still living. Numerous insects of widely different orders are attacked by a great number of species of spheriaceous fungi.

Certain species of fungi often prove quite destructive to fish, especially to the young fry. The ova of toads and frogs have been found penetrated by this same aquatic fungus. The mycelia of fungoid plants have been found in the tissues of birds, and even the ovum is not exempt, as Signor Pancery, of Naples, discovered no less than seven species in the albumen of hen's eggs. May we not have here a hint as to the manner in which hereditary diseases are transmitted from parent to offspring? Man is subject also to the deleterious influences of fungoid organisms. Mr. Hogg has discovered as many as fourteen different forms of fungi in as many different cutaneous diseases. Scald-head, ring-worms, tetter, etc., are produced in this way.

Many, if not most, of the diseases to which man is liable, are the effects of living germs of a fungoid nature. Ague, typhoid, typhus, scarlet and yellow fevers, small-pox, cholera, measles, diphtheria and other diseases are believed to originate in this cause, and in regard to many there is no longer any doubt. Consumption has recently been traced to the existence of bacillus in the pulmonary organs.

A common disease in India, called Madura foot, is caused a by fungus, the mycelium of which penetrates the tissues of the foot, changing the flesh and bones to a diseased mass full of cavities and channels. We are therefore led to the conclusion that a knowledge of the nature, history and habits of fungoid vegetation is intimately related to the welfare of the human family, and should be more generally studied and understood than has hitherto been the case.

There are some peculiarities belonging to some of the members of this class of vegetation that may be of interest to notice before leaving the subject. While many of them have the spore or sporidia-bearing surface exposed to the light, others seem to avoid this position, constantly keeping the fruiting surface turned away from the light. An illustrative example of this is found in Polyporei, which are so averse to direct light on the hymenium that, if the plant be reversed so as to expose that side, the fructiferous surface is gradually obliterated and a new one is formed on the under surface. In many fungi, if a cut surface be exposed to the air it is soon changed in color, generally to a blue tint. The Boleti may be cited as an illustration of this property. When a slice of B. luridis or of B. cyanescense is exposed it soon acquires this color, caused, according to Dr. Phipson, by the action of the ozone of the atmosphere on the acetate of aniline

that is found to be a constituent of these fungi. A remarkable phenomenon attending some fungi is the emission of a considerable degree of heat. The Boletus æneus is declared by Dutrochet to evolve more heat than any other vegetable known except the Aurum. But a still more remarkable phenomenon manifested by fungi is the emission of light. Numerous fungi in different parts of the world possess the property of luminosity. Agaricus olearius, growing on the olive trees in the south of France possesses this quality in a high degree. Also A. gardneri, a fungous parasitic on the Pintado palm of Brazil, is noted for its luminosity. Luminous fungi are quite common in this country. We have often seen large surfaces of decaying timber giving out a very brilliant phosphorescent light from the numerous mycelia that had penetrated the pores of the wood. This luminous wood, under the name of "fox fire," is often exhibited by boys as a curiosity.

The cause of this luminous property of fungi has been the subject of much controversy, but as in the experiments of M. Tuslane the luminosity was extinguished in a non-respirable gas, and also in vacuo, it is quite probable that it is the result of a slow combination of the oxygen of the air with some property peculiar to the plant.

Another notable phenomenon observed in some, especially in the spores, is the motile power they possess. Some spores are furnished with cilia which, by their contraction and expansion, enable the germ to move about like a thing of life. Some of these, especially the Myxogastres, so nearly simulate the animal amœbæ in their motions that many naturalists have insisted on placing them in the animal kingdom; but this view is now generally abandoned and they are accorded their proper place among vegetable organisms. Fungi differ exceedingly in the odors they emit, some of them being very agreeable while others send out a most intolerable stench.

The writer well remembers, when a boy, of searching the woods for a certain species, probably a Polyporus, that grew on the decaying timber of the sugar maple, acer saccharinum, and exhaled a very agreeable, musky flavor when not inhaled too strong, for in that case it was too pungent to be pleasant. Of the fruiting germs, their mode of production, fertilization, distribution, germination and growth we might speak at length; and here we might find one of the most interesting fields for investigation in all the vegetable kingdom, but space forbids our entering into this interesting part of the subject, and we must be content to have taken this cursory glance at the part of the field noticed and with a faint hope that at some future time we may be able to learn more of these objects, among the most minute and wonderful of all the works of Nature.

THE FLORA OF THE DAKOTA GROUP.

CHARLES H. STERNBERG.

If the reader will go with me in imagination, we will visit the shores of the great cretaceous ocean that once beat against the carboniferous hills. We have to roll back the centuries, several thousands of them, when Time was not near so grey as now. We walk along the boundless sea whose western boundaries no scientist has ever traveled. We find the eastern coast-line of this great ocean enters Kansas near the mouth of Cow Creek and taking a northeasterly direction, passes through Dickinson, Cloud, and Washington counties; and in the same direction through Nebraska, touches Iowa, through Minnesota into British America, and so on to Greenland. Great sand flats are projected above the waves during low water, while here and there, often miles apart, islands lift themselves above the waves. They are covered with luxuriant forests.

We will visit these islands and study their magnificent flora. We find they closely resemble the trees of our own southern shores. Here the grand Redwood or *Sequoia* reaches 300 feet into the air; beside it, the magnificent Catalpa, *Protophyllum*. Here a grove of elegant Poplars, *Popular Elegans*, delights the eye; their beautiful leaves waving backward and forward at the slightest breeze. Near by are clumps of Sassafras, *Sassafras Mirabile*, with leaves that measure a foot across. I am writing as though all these species grew near together, which is not the case, as each island has its own peculiar flora.

Yonder a stately Menispermites lifts its magnificent head into the air, one of the finest known trees that is now cultivated in our conservatories, on account of its beautiful foliage; then comes that other grand tree, with numerous species, *Liriodendron*, or Tulip tree, with its peculiar anchor shaped leaves. We find also another wonderful tree, with leaves a foot in length. They are thick and leathery, with powerful ribs, the mid-rib being perfoliate, i. e., passing through the leaf near its base; the margin of the leaf is wavy. This species has no representative living. The genus and species being both new to science. I discovered it in but two localities, one near Fort Harker, the other a few miles from Minneapolis, 100 miles apart; it is called *Aspidrophyllum Trilobatum*.

Another beautiful tree that is much sought for now by ornamental gardeners, is the *Aralia*, or Sweet Gum. Its graceful leaves have from three to five lobes, that are cut down nearly to the mid-rib. One magnificent species, *Aralia Saporteana*, has serrated lobes.

The Sassafras is the most common of cretaceous plants, represented by numerous species. One, *Sassafras Mudgii*, resembles the Sassafras of Ohio.

On the ground under the trees grow the pretty fern *Gleichenia Turriana*.

The Cinnamon and Fig *Ficus*, are represented by numerous species.

I discovered a number of figs that were new to science. The Beech, *Betula*, is also found.

These species show that the climate resembles that of Virginia. Conifera are represented by *Glyptostrobus Gracillissimus*, resembling the *Norway Pine.* I found their cones, but they are rare.

Liquidambra Integrifolia with its lobes cut down nearly to the middle, is quite a common cretaceous plant; Willows, *Salix;* Black Walnut, *Juglans;* Oak, *Quercus;* Maple, *Acer;* Bass-wood, *Platanus;* Magnolia, *Rhamnus;* Box-elder, *Negundoides* and Plum, *Prunus,* are common in the Dakota flora. Another tree with fern-like leaves, *Todea Saporteana*, is found. One species with parallel veins, *Phragmites,* is the only species I discovered in the cretaceous with veins arranged in this way, proving that the climate did not resemble that of the tropics, where the Palm with parallel veins and others like it, are in the majority.

One very peculiar species, the *Eremophyllum Fimbriatum,* has leaves that are dental from their lower margin, with equal short teeth, appendaged with obtuse auricles, and separated by half-round sinuses.

Searching along the mud-flats, we find numerous leaves have fallen in and are partly covered. Lifting one up carefully, we find beneath, an exact cast of the leaf, and thus have the impressions, we find now in the sandstone of the Dakota, been made. Often the soft sand was by pressure packed into solid rock, the impressions were indelibly stamped.

The noted Palæo-Botanist, Prof. Leo Lesquereux, has been able through these impressions, to study the whole Dakota flora and identify the species as readily as if the trees were before him. His interesting work, "The Cretaceous Flora," has been published by the Government in Vol. VI, of the Geological Survey under Prof. F. V. Hayden. It is a magnificent work, beautifully illustrated with thirty lithographic plates. In a later work called "The Review of the Cretaceous Flora," he has described and figured twenty-five new species discovered by myself, and later, during my expedition for Prof. Agassiz, I discovered twenty new species, and 800 specimens beautifully preserved, that have been described by Prof. Lesquereux. About 200 species of forest trees have been discovered in the sandstone of the Dakota Group, and described by the Professor and Doctor Newberry.

This Dakota Flora is a wonderful disproof of the theory of Natural Selection. Here we find at the base of the cretaceous, millions upon millions of years old, a flora as perfect as any of the present day. There has been no improvement during all these ages. Some of these species are called new, more on account of the position in which they are found, than from any dissimilarity between them and those of recent species.

What has Nature been doing in the vegetable kingdom during these countless centuries? Is the line of development confined only to animals? And more wonderful still, these perfect plants appear for the first time in the earth's history. Like the hero of old that came into the world full-grown and ready armed, so the grand flora of the Dakota appeared with no intermediate species between it and the coal plants of the carboniferous. Let the scientists of the Darwinian

school explain this fact and make it conform to the theory of Evolution if they can.

Another proof of the richness of the vegetation during the Dakota epoch, is fonnd in the fact that nearly all the sandstone laid down during that time, is strongly impregnated with iron, showing that it had been first accumulated by plants. There are also beds, of considerable extent, of impure coal, that is mined and used by people for fuel in western Kansas. In addition to the sandstone, are beds of shales and various colored clays. Some of them contaian iron pyrites, crystals of gypsum and alum. I once found a spring flowing from a bed of shale that contained so much alum that the taste was quite perceptible. Scattered through the formation are enormous sandy concretions, often twenty feet in diameter, circular in shape, flattened above and below; two or three are often joined together. They sometimes rest on softer rock, which has been washed into pillar-like supports, and they resemble large mushrooms. The rocks of the formation are estimated to be about 200 feet thick. I have traced the same formation in Texas, near Weatherford, where they top the limestone of the Permian. In one place I saw an escarpment of red sandstone thirty feet thick; it contained fragments of *sassafras cretaceum.*

In searching for fossil-plants, there is nothing to indicate their presence. The sandstone is all the same, and one may look at every exposure with no results for miles, and perhaps suddenly stumble upon a rich locality in the same kind of rock. The sandstone makes fine building material.

In this formation, I have found a locality of fine white sand which I use in making a scouring soap. The deposit is eighty feet long, twenty feet thick, and extending into the bluffs. The surface features of this group are a broken, hilly country, often so rough, in fact, as to be unfit for farming, though it makes a good range. Fine springs of pure water gush out of the hill-sides that do not freeze in the coldest weather. These springs are sometimes utilized in milk-houses, and the water allowed to flow around the sides of the milk-pans, keeping them at an even temperature. In Kansas the formation is about sixty miles wide, except along the Arkansas, where it extends to the western boundary of the State.

That the rocks are of marine origin, is proved by the presence of sea shells. They are quite abundant south-east of Brookville. No animal remains have been found, unless the theory of Prof. Cope is correct. He claims that all the wonderful remains of dinosaurs found in Colorado, belong to this formation. Some of these enormous reptiles reach a height of twenty-five feet, and length of sixty feet. They are the largest known land animals and were herbivorous in habit, feeding on the branches of trees. Prof. Marsh places the deposit in the Jurassic age. Whether fossil plants have been found associated with the bones or not I am unable to say, neither can I give the data from which Prof. Cope forms his conclusions.

A vast territory in the Dakota group remains still unexplored and promises a rich harvest of things, new and old, to the ones who will be enabled to give the whole formation a careful examination. I trust it will be done at an early date.

I give below a list of the localities where fossil leaves are found, which will be found of value to any one who may wish to make collections. From what I have written, you will see how rare these localities are. It will also be interesting in showing the distribution of Dakota plants.

1. Near the bridge on Thompson Creek, at Mr. Scott's place, seven miles south of Fort Harker. Characteristic species: *Sassafras mirabile, S. cretaceum, S. obtusum, Cissites harkeranii, Menispermites ovalis, Sequoia formosa, Photophyllum sternbergii, P. minus, Glyptostrobus gracillissimus, Laurophyllum reticulatum.*

2. Two miles above the bridge on Mr. Hudson's place called Rye Hollow: *Ficus sassafras cretaceum* and *obtusum.*

3 Sassafras Hollow, seven and one-half miles south of Fort Harker near mouth of Dry Creek: *Sassafras cretaceum, S. Obtusum* and *S. mirabile, Protophyllum sternbergii, P. minus, P. quadratum,* and *P. rugosum.*

4. Hay-stack Mountain near Bluff Creek, twelve miles south of Fort Harker: *Liquidambra integrifolia, Aralia concreta, Sassafras cretaceum, S. mirabile, S. obtusum, Protophyllum sternbergii, P. minus,* and *P. rugosum.*

5. Three miles south of Fort Harker, above high bluffs, on the river: *Aralia quinquepartita, A. tripartita, A. saporteana, Lamophyllum reticulatum.*

6. Five miles south-west of Fort Harker, on Skunk Creek, above John Essick's place: *Glyptostrobus gracillissimus, Pinus,* leaves and cones. *Sassafras,* several species. *Populites elegans, Liquidambra integrifolia,* Ferns, etc.

7. Six miles southwest of Fort Harker, on Ash Creek, near Mrs. Ward's place: *Liquidambra, Sassafras* and *Platanus.*

8. South of Fort Harker, on Skunk Creek, on Mr. Hoofland's place: *Aralia saporteana, A. tripartita, Daphnegenoides protofolia, Laurus nebrascensis.*

9. Skunk Creek, Section 36: *Betula beatriciana* and *Laurus nebrascensis.*

10. Elk Horn Creek, twelve miles northeast of Ellsworth's: *Liriodendron cruciformæ, Salix protofolia, Liriophyllum* and *Phragmites.*

11. Six miles northwest of Brookville, near Mr. Sherman's: *Aralia saporteana.*

12. Mulberry Creek, fifteen miles northwest of Clay Center: *Platanus heerii* and *Sassafras.*

13. Seven miles northeast of Glasco: *Phragmites, Salix, Fagus, Betula, Seltis,* etc.

14. Two and a half miles southwest of Glasco: *Liriodendron,* 3 species—*Todea, Pteris, Magnolia, Laurophyllum, Fagus, Celtis, Quercus, Glyptostrobus, Aralia, Liquidambra, Populites, Juglans, Cinnamom, Sequoia* and *Phragmites.*

15. Two miles northeast of Minneapolis: *Sassafras* and *Cissites.*

16. Four miles northeast of Minneapolis: *Aspidrophyllum trilobatum* and *Populites.*

17. Twenty miles above Salina: *Sassafras Mudgii, Cissites, Menispermites, Obtusitola.*

18. Four miles southeast of Fort Harker: *Aspidrophyllum trilobatum, Aralia, Downeri,* etc.

ENTOMOLOGY.

RECENT PROGRESS IN ECONOMIC ENTOMOLOGY.[1]

PROFESSOR C. V. RILEY.

The paper set forth the part which insects play in the economy of nature and particularly their influence on American Agriculture. The earlier writers on applied entomology in the United States, as Peck, Harris, Fitch, Walsh, LeBaron, and Glover, did some excellent work in their studies of the habits and life-histories of injurious species, but the most important results followed when such studies were combined with field work and experiment by competent persons and upon scientific principles. A number of the remedies proposed in the agricultural press are foolish and based on misleading empiricism. Economic entomology as a science is of comparatively recent date. It implies full knowledge of the particular injurious species to be dealt with and of its enemies; of its relations to other animals and to wild and cultivated plants. In short, its whole environment must be considered, especially from the standpoint of the farmers' wants. The habits of birds, more particularly, and the bearings of meteorology and of the development of minute parasitic organisms, must be considered. Experiments with insecticides and appliances will then be intelligent, and successful in proportion as the facts of chemistry, dynamics and mechanics are utilized.

The complicated nature of the problem was illustrated by the life-history of *Phylloxera vastatrix*, Planchon, and the difficulties often encountered in acquiring the facts were illustrated by the late work on *Aletia xylina*, (Say).

The chief insecticides considered for general use and applicable above ground were tobacco, white hellebore, soap, arsenical compounds, petroleum and pyrethrum; those for use under ground, naphthaline, sulpho-carbonates of potassium and bisulphide of carbon. The most advantageous and improved methods of utilizing each were indicated. Recent experiment showed that kerosene emulsions, such as had been recommended lately in the author's official reports, were superior to bisulphide of carbon, when used under ground against the grape *Phylloxera*, and the discovery is deemed of great importance, especially to the French people, and those on the Pacific slope. Contrary to general belief, Pyrethrum powder was shown to have a peculiar and toxic effect on higher animals as well as on the lower forms of life. Its deadly influence on lower organisms led the author to strongly recommend its use as a disinfectant and to express the belief that it would yet come to be used in medicine. Dr. Hagen's recommendation of the use of yeast ferment was touched upon. It had proved of little or no practical avail

1. Abstract of a paper read before the Philosophical Society, Washington, D. C., at its meeting February 2, 1884.

and some of the publications on the subject were characterized as unscientific. The use of malodorous substances as repellents which had been much relied on in the early days of economic entomology and strongly recommended by the two Downings, had lately been agitated as a new principle for the prevention of insect attack by Professor John Lintner. The principle could be applied in exceptional cases to advantage, but experiment gave but little hope of its utility against most of our worst field insects. Professor S. A. Forbes is engaged in interesting researches having for object the utilization of micro-organisms, but with more promise for pure than applied science.

Of recent progress in mechanical appliances the paper dealt with those lately perfected under the author's direction of Dr. W. S. Barnard, one of his assistants. This part of the subject was illustrated by models and by plates from the forthcoming Fourth Report of the U. S. Entomological Commission.

The paper concluded with the following plea for applied science: "Matters of fact do not tend to provoke thought and discussion, and I must confess to some misgivings in bringing these practical considerations before a body which reflects some of the highest and purest science and philosophy of the nation. From the days of Archimedes down to the present day there has existed a disposition to decry applied science and to sneer at the practical man. Yet I often think that science—no matter in what fine sounding name we clothe her, or how high above the average understanding we stilt her—is, after all, but common sense employed in discovering the hidden secrets of the universe and in turning them to man's wants, whether sensual or intellectual. Between the unbalanced vaporings of the pseudo-scientific theorizer and the uninformed empiric who stumbles upon a discovery, there is the firm middle-ground of logical induction and deduction, and true science can neither be exalted by its inapplicability nor degraded by its subserviency to man's material welfare. The best results follow when the pure and the applied go hand in hand; when theory and practice are wedded. Erstwhile the naturalist was honored in proportion as he dealt with the dry bones of his science. Pedantry and taxonomy overshadowed biologic research. To-day—largely through Charles Darwin's influence—we recognize the necessity of drawing our inspiration more directly from the vital manifestations of Nature in our attempt to solve some of the many far-reaching problems which modern science presents. The fields of biology, morphology, physiology and psychology are more inviting than formerly. Nor is the lustre that glorifies the names of Stevenson, Watts, Faraday, Franklin, Morse, Henry, Siemens, and a host of yet living investigators dimmed because they made science useful. Gœthe makes Wagner say:

> "Ach wenn man so in sein Museum gebannt ist
> Und sieht die Weltkaum einen Feiertag,
> Kaum durch ein Fernglas, eur von Weiten,
> Wie soll man sie durch 'Uberredung leiten?'"

If to-day, right here in Washington, there is great activity in the field of

original research; if the nation is encouraging it in a manner we may well be proud of, the fact is due in no small degree to the efforts of those, many of them members of this Society, who have made practical ends a means, rather than to those who would make science more exclusive and who are indifferent to practical ends or popular sympathy. Such at least is my apology for the nature of this paper.

PHYSICS.

ON THE PROGRESS OF ELECTRIC LIGHTING.[1]

WILLIAM HENRY PREECE, F.R.S.

I propose briefly to indicate some of the progress made, both in a scientific and practical sense, and to show that electric lighting is a real, true success.

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As regards the scientific progress little has to be said. We had learned nearly all we wanted to know before electric lighting had entered its practical stage. In reality, the very fact that it had entered its practical age was a proof that it had passed through its infancy of scientific tuition. The conditions that determined its production, the laws that regulated its behavior, the means that were available for its control, had all been thoroughly investigated and laid down before practice stepped in to show us what could be done.

Electricity can be produced, currents can be distributed, light can be generated, but we have yet to learn how all this can be supplied economically, profitably, and with safety to person and to property. Practice alone can determine these points, and it is well to make a rapid survey of the extent to which practice has up to now enabled us to solve these points. The future of electric lighting is now in the hands of practical men.

Electric lighting has called for motors of a class not hitherto in demand, and steam, gas, and water engineers have rushed to the front to meet the demand. The production of electric currents means the expenditure of power; and when the extent of the installation is known, it is a simple calculation to specify how much horse-power is needed. Some employ a fall of water to urge a turbine, others employ steam, many use gas to obtain the power requisite to convert the energy of mechanical motion into that of electric currents. Gas-engines are being very largely used, and since the expenditure of a given amount of gas as power, will produce more light through the agency of electricity than by direct combustion in air, it is clear that we have here an evidence of the true function of gas. The perfect gas-engine has not yet been produced. Those in use are

1. Paper read before the Society of Arts, London, March 5, 1884.

too noisy, too irregular, and sometimes uncertain, but the advances made are very marked and very encouraging. The hall in which we are is, as you see, brilliantly illuminated by a gas-engine. Those little lamps, though electric glow lamps, are in fact lighted by gas, though the gas itself is consumed in the cellar. The light we enjoy is only a form of the energy which has been brought into this building by the Gas Light and Coke Company. In all cases of electric lighting electricity is merely the agent which transforms the pent-up energy contained in water, steam, or gas, into that of light. Hence it is that so much of the efficiency of electric lighting apparatus depends upon the instrument called the "dynamo," by which the conversion of this energy is brought about, and here it is that so much inventive skill has been expended, and so much real progress has been made.

The tendency of recent improvements has been to improve the mechanical details, and to increase the output of the smaller machines. Thus by increasing the quantity and quality of iron, by better winding, and by re-arranging some parts of the machines, Dr. Hopkinson has succeeded in doubling the output of the Edison dynamo. Mr. Crompton, by somewhat similar means, and by using the purest iron obtainable, has succeded in making his Bürgin dynamo light up 210 lamps, instead of 90. Sir William Thomson and Mr. Ferranti have turned out a little machine which succeeds in lighting up 1,000 lamps by a mass of metal, which two years ago would not have illuminated 100 similar lamps.

Thus we have a process which is still actively going on, by which the economical output of a given weight of material is vastly increased.

One of the most interesting objects at the Fisheries Exhibition last year was the Hochhausen dynamo, which is one of the most remarkable yet brought into the market. Those who visit the forthcoming Health Exhibition will have an opportunity of inspecting it. The main features of this dynamo are the extreme simplicity and mechanical accuracy of its parts, the automatic mode of governing, its great adaptability, so that it can be varied at will either to high or low tension, and the remarkably low velocity for such high electro-motive force.

The distribution of the currents through conductors is one of the problems that demands the highest skill of the engineer, not alone for the efficient working of the system, but for its economy. It is not sufficient to convert our useful energy into electric currents, we want to distribute them with the least possible waste. Conduction means waste, and this waste can be controlled only by using the purest metal, and by so regulating the electro-motive force and dimensions of the conductor as to obtain the maximum effect with the minimum means. It is an exceedingly difficult problem to solve. The metal universally used is copper, but very few people take the precaution to test its purity, Contractors go to the cheapest market, and the result is they get the nastiest material. I know of conductors that give only 70 per cent of the conductivity that they should give. This means largely increased waste, and greatly enhanced cost of working. Impure copper not only means needless waste, but waste means heat, and therefore danger.

But wasted energy may also take the form of leakage, or direct loss of current. This is cured only by good insulation. Good insulation unfortunately means expense; and here again competition has forced too much economy. I have not examined one single case of the failure of an electric light that has not been traceable either to crass ignorance, or to needless economy. Perfectly well insulated copper conductors are within the reach of all who choose to pay for them; but when proper specification, proper inspection, and proper tests are neglected, we must expect, as has too often happened, failure and expense.

A marvellous improvement has been made by Dr. John Hopkinson and by Mr. Edison, independently of each other, by which the weight of copper necessary for central station working has been diminished 60 per cent, and this is due to the use of two dynamos connected in series, and a third, or compensating conductor, placed between them. The weight of copper necessary for a conductor can also be diminished by the use of high tension currents, and this has led to various suggestions by which high tension currents shall be used for charging secondary batteries, and for exciting induction coils, but the use of high tension currents for household purposes is at present regarded as dangerous. High tension currents are, however, available for public street lighting, and are very satisfactorily employed for this purpose. There is a very senseless crusade being conducted just now in certain quarters against overhead wires. Overhead wires, if properly constructed, are most desirable, especially for electric lighting. It is the terrible abuse of this mode of construction that has caused the present onslaught upon them. Overhead wires can be made absolutely secure; they need not be a disfigurement nor an injury; they are far more readily maintained than underground wires; they facilitate the economy of electric lighting, not only by affording better conductors, but by radiating away the waste heat generated, and by requiring fewer joints and connecting points.

I do not in the least object to overhead wires through our streets for public lighting, though I strongly object to the cloud of wires that now obstruct the sky line in many of our thoroughfares. When ugly objects form an essential function of utility, it is wonderful how their unsightliness is condoned. Who complains of the ugliness of gas lamp-posts, and what is there in the necessary adjuncts of town life more ungraceful or hideous?

I do not, however, advocate overhead wires for general lighting. The conductors in that case must go underground, and with the great demand for telegraphs, telephones, and electric lighting, it is a pity that our corporations do not extend that useful system of subways, that has been partially carried out in the City of London, for easy fixing and inspection. The present mode of laying pipes in trenches is not only costly, but dangerous, and it has led to many more accidents than have been occasioned by the falling of overhead wires. Our streets are almost always open for either gas, water, telegraphs, or telephones, and the evil is increasing, and will continue to increase, with electric lighting. The cure is proper subways.

The progress made during the past two years in the form and character of lamps, whether arc or glow, has not been very marked. In arc lamps the tendency has been to simplify the working parts, and to increase their steadiness of action. The Crompton, Pilsen, and Fyfe-Main lamps leave little to be desired in this respect. At the Vienna Exhibition there was a remarkably steady lamp in the French Section, the Abdank lamp, but it has not been seen in England yet. The arc lamp has many serious defects, which circumscribe its value very considerably, but it is eminently adapted for workshops, railway goods yards, and for large spaces where high masts can be fixed.

For general domestic illumination the glow lamp, as made by Swan and Edison, is, in my opinion, the only proper one. At the Munich and Vienna Exhibitions, a remarkable lamp by Cruto, of Turin, was shown. It gave very good results, and absorbed a very small current, but it is not in the market yet. At Vienna the Bernstein lamp attracted much attention. It was a thin carbon tube made by carbonizing a hollow silk ribbon, but it had low resistance, and required much current. It gave a considerably higher candle-power than we are accustomed to. For instance, one lamp requiring 5 ampères and 30 volts, gave 60 candles; and another, with 8·5 ampères and 35 volts, gave 100 candles. Its normal efficiency of 2·5 watts per candle was very low, the efficiency of the Swan lamp being 3·5 watts per candle, and that of the Edison 4 watts per candle. Its duration is said to be very great. All glow lamps can be made to give economical results when we use large currents, but, unfortunately, their life is much curtailed by doing so. The filament is disintegrated, and the inside of the glass is, in consequence, covered with a dark deposit. Hence we are obliged to be satisfied with low efficiency to obtain reasonable durability.

The Bernstein lamp is, however, of an inconvenient power, and while it may do for street lighting, and for large spaces, it is not adapted, in its present form, for our rooms and offices. It is, therefore, a lamp that is more likely to replace arc lamps than the present glow lamps, as made by Edison and Swan. It has, however, shown us a direction in which economy can be effected, and we may reasonably hope that the workers in this field will soon find a means to improve the present efficiency of the small glow lamps, and thus reduce the cost of working them.

A good many private houses, as well as public establishments, have been recently fitted up, and their experience has developed many difficulties and dangers which have only to be found out to enable them to be overcome. There is no use ignoring the fact that the admission of electric currents into our homes means the admission of a new danger—a danger that is only to be surmounted by the dictates of experience. Careful rules and regulations have been drawn up for the guidance of those who are executing installation, but the true remedy is to employ none but skillful and experienced contractors, and to have premises properly inspected by recognized professional men. Under such guidance electric light leads can be made absolutely harmless and devoid of all danger. The same cannot he said of gas, oil, or candle, for they involve the use of matches,

and are always in a condition of potential danger. 2,041 persons in England alone, in 1881, met with violent deaths from burns, scalds, and explosions (not in mines). In one week, not long ago, six deaths from explosions of gas were recorded in the *Times*. Hence, while electricity is certainly accompanied by its own dangers, these dangers can be neutralized, and other infinitely more serious ones can be completely expelled from our houses.

Mr. Killingworth Hedges has devoted a great deal of attention to safety catches, and he certainly has produced the most efficient that are in the market. No electric light lead should be without its safety plug or cut-out. It is a precaution of a cheap and simple character, efficient, and reliable in action. A bar or sheet of lead, or alloy, is inserted in the circuit, which is instantly fused when from any cause the current exceeds its proper amount. It is a nuisance to be left in the dark, which must happen when the safety catch is fused, for the circuit is broken; but one can submit to this when the result is safety gained, or some source of danger eliminated. The remedy is a little barbarous, but it is efficient. A less crude contrivance was shown in Vienna—the invention of Mr. Anderson—but I have not seen it in practice.

It is most desirable that we should have, in every electric light installation, instruments to measure the current flowing and the electric pressure present. Ammeters, or current measures, and voltmeters, or pressure indicators, are very numerous.

Another important economical feature is the proper distribution of light, and Trotter's dioptric system is very ingenious and useful.

I scarcely think that the true solution of isolated house lighting will be secured until we can obtain reliable, effective, and economical secondary batteries. Plante's original accumulator, as improved by Faure, Sellon, and Volckmar, has not yet reached that stage of perfection that one would wish to see, but the progress towards this desideratum is steady and promising. Planté has himself made a decided improvement by preparing his lead plates in nitric acid, and the experiments that I have made with his cells, as supplied by Elwell and Parker, of Wolverhampton, are so encouraging that I am about to use a set of them in my own house. A secondary battery has this advantage, that your electricity is stored up to be used when you want it, by day or night, without the constant use of machinery. In ordinary houses, such as mine, there ought not to be required more than one day a week for charging—a day set apart for the purpose like washing-day—when sufficient electricity should be stored up for a week's work. I scarcely hope to do this yet, but it is well within the bounds of possibility.

I have indicated to you the direction in which progress has been made. The output of the apparatus has been greatly increased, and, therefore, the capital required for installation reduced, the expenditure on conductors has been considerably diminished, the efficiency of the lamps—especially in their durability—has been improved, and all these steps in advance have the tendency to economize the production of the electric light. But the progress is being continued, and

there is vast room for this improvement. Nothing approaching finality has yet been reached.

I see no reason whatever why our public streets should not be as efficiently lighted by electricity as they are now by gas, and for the same price. But the public are not satisfied with the same illumination; they will have more light. They are spoiled by the dazzling splendor of the arc lamp, and they treat with contempt the less showy glow lamp. Nevertheless, the best lighted street in the City of London is the Holborn Viaduct. The Thames Embankment and Waterloo Bridge have now been lighted by fifty arc lamps for over five years by the Jablochkoff Company. Blackfriars Bridge, Bridge Street, Ludgate Hill, St. Paul's Churchyard, and Cheapside have been lighted by thirty-eight Brush arc lamps for three years. We are now engaged in a very interesting series of experiments at Wimbledon, to determine the best and most efficient way of lighting public streets, and much value in an economical sense will, it is hoped, accrue from these trials.

It is remarkable how the use of electricity is growing in favor with theatre managers. Supported by the success of the Savoy, the Criterion, and the new Prince's Theatre in London, the Prince's Theatre in Manchester, the Prince of Wales and the Royal Theatres in Birmingham, two theatres in Glasgow, and many others, are following Mr. D'Oyley Carte's spirited venture, and who can refrain from wishing that all would follow his example? Cool and pure air, absence of headache, and cheerfulness of mind are experienced at the Savoy, while the reverse is felt elsewhere where gas is used. I have recently examined the estimates for lighting up the Opera House in Vienna, and I have every reason to believe that less than 30s. per lamp per annum will brilliantly illuminate that beautiful house, and give a handsome return to those who have undertaken the contract.

There are many small central stations at work in England, but none on a large scale. At New York there are several. The Edison Company's first station lights 431 houses, and 10,300 lamps, and they are now erecting two new ones for 50,000 and 70,000 lamps respectively. We have in London one at work on the Holborn Viaduct, another at Brixton, and another for 5,700 lamps will shortly be opened at Victoria Station. There are small central stations at Godalming, Chesterfield, and Colchester. The Hammond Company have one at Brighton, which works over an area of seven miles. This company maintains 900 arc lamps and 5,500 glow lamps in different places in England. There is a central station at the Edgware Road Station of the Metropolitan Railway, whence Notting Hill Gate, Gower Street, King's Cross, and Aldgate Stations are lighted over a length of fifteen miles long. One hundred and fifty-one glow and five arc lamps are illuminated by the distributing system of Gaulard and Gibbs. Lord Salisbury, an amateur electrician of no mean type, has established quite a system of his own at Hatfield. The *Times*, ever in the van of progress, has for four years lighted up its printing and compositors' room.

Our new Law Courts are admirably lighted, and some of the judges have

said that the electric light is the only good thing in this new Palace of Justice. The House of Commons has gradually been fitted up, and the Colonial Parliament Houses in Cape Town and New South Wales are following the examples. Indeed, restaurants, hotels, and public buildings are all testifying to the fact that I am so anxious to bring before you, that electric lighting is a decided success, for they are using it. But we want to see it in our homes. An excellent little book on this point has recently been published by Mr. Hammond, which is well worth your perusal. He has given there a table so striking and convincing that I have had it copied and suspended for your information:

The following table shows the oxygen consumed, the carbonic acid produced, and the air vitiated by the combustion of certain bodies burned so as to give the light of twelve standard sperm candles, each candle burning at the rate of 120 grains per hour:

Burnt to give light of 12 candles, equal to 120 grs. per hour.	Cubic feet of oxygen consumed.	Cubic feet of air consumed.	Cubic feet of carbonic acid produced.	Cubic feet of air vitiated.	Heat produced in lbs of water raised 10 deg. F.
Cannel Gas . .	3·30	16·50	2·01	217·50	195·0
Common Gas. .	5·45	17·25	3·21	348·25	278·6
Sperm Oil . . .	4·75	23·75	3·33	356·75	233·5
Benzole	4·45	22·30	3·54	376·30	232·6
Paraffine	6·81	34·05	4·50	484·05	361·9
Camphine . . .	6·65	33·25	4·77	510·25	325·1
Sperm Candles .	7·57	37·85	5·77	614·85	351·7
Wax.	8·41	42·05	5·90	632·25	383·1
Stearic.	8.82	44·10	6·25	669·10	374·7
Tallow.	12·00	60·00	8·73	933·00	305·4
Electric Light .	none	none	none	none	13·8

There you see why the electric light is so pure and so healthy. There is no consumption or pollution of air. There is the smallest possible production of heat. There are none of the existing dangers from fire or suffocation, but all is pure, healthy, and safe.

Our homes on the seas—those ocean palaces that render voyages to America and our colonies a pleasant yachting picnic—are being gradually fitted. Over sixty are already so fitted, and all will soon be done. None but those who have tumbled and tossed on the angry ocean in a pitch-dark confined crib for the seemingly never-ending night, can appreciate the peace and comfort of the soft and gentle little glow-lamp that is now supplied.

Efforts are being made to introduce primary batteries for the generation of electric-light currents, but not as yet with marked success. Unless the products of combustion can be sold profitably, primary batteries must necessarily be costly, and their constant renewal, and the amount of personal supervision they demand, militates much against their use, but some admirable batteries for small and temporary installations have been brought out, notably that of Mr. Holmes. Our railway trains are being lighted. Very satisfactory experiments are being made

on the Brighton, South Western, South Eastern, Metropolitan, Midland, and Great Northern Railways, with dynamos, primary and secondary batteries, and there is no doubt whatever of their ultimate success. There is no reason why the energy of the moving train itself should not produce currents of electricity to illuminate every compartment with the light of day.

Exhibitions have been both banes and antidotes. They have had much to do with the cause of the late mania, but they have also encouraged invention, and stirred up emulation. Last year's Fisheries Exhibition did much to educate Londoners to the advantages of the light. This year's Health Exhibition will do more; and I venture to prophesy—a foolish practice unless you know—that this Exhibition will, as an electric light display, be the best we have ever seen.

There have been a good many failures in electric lighting, as there must be in the introduction of every new enterprise, but every failure can be traced to imperfect apparatus, or to the employment of inexperienced contractors—in fact, to bad engineering. It is not long since that the wiring of a large building was let to one firm, and the lighting to another, with the necessary consequence that the whole thing "burst up," to use an Americanism, on the night of opening.

It is difficult to express any opinion on the economy of the electric light. We have not had the experience of any central lighting station of sufficient magnitude to justify the formation of such opinion. Any comparison between gas and electricity on this basis is unfair, because gas is produced in quantities sufficient to supply hundreds of thousands of lamps, while the largest electric light station yet erected does not light up 10,000 lamps. In New York, the price is the same for electricity as for gas, but then gas costs 12s per 1,000 cubic feet, as it did in London, in the memory, perhaps, of some present. Nevertheless, the cost of supplying electricity now is far less than was the cost of supplying gas in the early days of its introduction.

But why draw a comparison? People do not compare the cost of gas with that of candles, nor the price of a pheasant with that of a mutton chop. If we want a luxury we must pay for it, and if the price of the luxury is not too great, people will have it. People will have electric light, if it can be supplied to them, not because it is cheap, but because it is, safe, healthy, pure, soft, and natural. And, moreover, they will not object to pay any reasonable price for it, whatever may be the price of gas. Gas is most destructive, unhealthy, and objectionable when used for artificial illumination. The proper function of gas is the production of heat, and we see in this room how this production of heat can be utilized to form electric currents which diffuse about us a real luxury—pure light. When the electric light can be supplied, questions of sanitation, ventilation, and decoration will determine its use, and not questions of price. At present, for household purposes, it is a luxury for which we must pay; but the progress made is so rapid, and the room for improvement so great, that the day is not far distant when we shall cease to regard it as a luxury, and shall demand it as a necessity. —*London Electrical Review.*

THE GULF STREAM.

WILLIAM HOSEA BALLOU.

Circulation is not confined to the blood of man nor to the currency of a government or bank. It is the essential factor visible everywhere in nature. The network of the rivers is the life blood of land, the winds of the atmosphere and currents of the ocean. It is death to stand long in the snow because the circulation of the system becomes blocked; thus circulation of some kind is necessary to the preservation of all the elements of nature, social and physical. Man dies when the circulation of the blood ceases. The land would similarly die, so far as habitation or cultivation is concerned, if the rivers should cease their flow. The air would similarly die and no longer afford refreshing breath should the winds cease and the cyclones fail to purify it. The ocean without its currents would soon die and its surface be blocked with dead fishes and lower forms of animal life. This earth will remain habitable just so long as these infinite methods of circulation are perpetuated, and when the force we call gravitation fails to circulate the orbs in space, the doom of the universe will be sealed.

The Gulf Stream is the largest and longest body of flowing water extant. We are to regard it as the steam pipe which conveys the heat from the equatorial furnace of the earth to points where the sun is not sufficiently operative. The amount of heat thus transferred is easily estimated at nearly eighty quintillions of tons annually. The evidences of geology exhibit this stream in a fickle light. It has not been constant in its devotion to Northern Europe and England. When it sought other idols, the cold currents flowing south occupied the greater part of the Atlantic and cooled the now moist westerly winds. Then in Northern France the Arctic fox, reindeer, and glutton prowled about. After this, there was a gradual change and the current returned with greater warmth than is now experienced, so that the fig-tree and canary-laurel flourished where Paris now is. Then it was that lions, tigers and elephants held sway in the valley of the Thames, and London was founded by the denizens of jungles. Some one has been foolish enough to express a fear that an isthmian canal would turn this powerful current into the Pacific Ocean, forgetting that the dimensions of such a canal would hardly average fifty miles in width by one thousand feet depth.

There are numerous theories in regard to the origin of this perpetual-motion current. The most ancient supposed the Mississippi river the parent, but it was found that its volume was one thousand times too small for the purpose, although its waters mingle with it. Captain Livingston ascribed it to a sort of yearly tide, conceived by the sun's apparent yearly motion and influence on the Atlantic. Dr. Franklin held that the stream was the reflux of waters piled up in the Gulf by the trade winds, but these gentle breezes only blow about 111 days per year and could not possibly pile up so much water. Besides, water being eight hundred

times heavier than air, it is scarcely presumed that the trade winds develop strength enough for such a task.

Captain Maury next took into account the action of the sun's heat. He believed that the water at the equator was made lighter by the action of the sun and flowed over the surface toward the poles. The cold water of the Polar seas rushed in to take its place, but being heavier, formed a submarine current.

Sir John Herschel maintained that such effects were impossible, since if the waters became lighter, they could only have an upward, downward or sidewise tendency. The latter could only result from the gradual sloping caused by the bulging of equatorial waters. Such a slope was too slight for such an effect.

Richard A. Proctor, the astronomer, next takes the stand and argues for a theory most generally held to-day. He proceeds to show that the great heat of the sun at the equator has a drying as well as a warming effect on the waters. It evaporates enormous quantities. This causes an intense suction to take place over the whole equatorial Atlantic, and a submarine current of cold waters from the Poles results and takes the place of the waters evaporated, also causing a surface flow of warm waters toward the Poles He says: "Having once detected the main-spring of the Gulf Stream mechanism, or rather the whole system of oceanic circulation—for the movements detected in the Atlantic have their exact counterpart in the Pacific—we have no difficulty in accounting for all the motions which that mechanism exhibits. We need no longer look upon the Gulf Stream as the rebound of the equatorial current from the shores of North America. Knowing there is an underflow toward the equator, we see there must be a surface flow toward the poles. This must inevitably result in an easterly motion, as the underflow toward the equator results in a westerly motion. We have, indeed, the phenomena of trade and counter-trades exhibited in water currents instead of air currents."

I protest in the name of every student who attended the district school twenty years ago, that this Proctorian theory is almost the exact wording of that of Francis McNally in his "System of Geography," then studied. Yet at that time, the Royal Geographical Society was questioning the very existence of the Gulf Stream. In brief, our unpretentious geographer, who made but a three-page analysis of the physical features of the earth, quietly advanced the only correct theory of oceanic currents which were only advanced in after years by the great scientists abroad as a result of a regular process of evolution of ideas, given in the last paragraphs. To my own mind, all the causes taken into consideration, which were either accepted or rejected, contribute their quota to oceanic currents. The vast volume of water constantly contributed by the Mississippi and tributaries, must render a portion of the prodigious force and volume of the Gulf Stream possible. The trade winds banking up waters in the Gulf, must add something by the reflux. The bulging of equatorial waters may contribute a little. Of course, the evaporation by the sun is more potent than all other forces combined, but Richard A. Proctor hrs not an iota of claim to priority for that theory.

The equatorial current is not continuous as a submarine flow. The United States Coast and Geodetic Survey, has prepared a map, showing an "inner cold wall" from outside New York to Cedar Keys, by which term is meant the equatorial current, flowing from the Arctic Sea. It is not surprising, then, that the warm waters of the Gulf sweep the bed of the ocean for many hundred and perhaps thousands of square miles. It consequently happens that its bed, as well as the Gulf Stream itself, has a distinct fauna and flora of its own, perhaps the most marvelous in any area of the globe. The dredging and trawl nets of the United States Fish Commission, in this area, have brought up literal thousands of new species of fishes and the lowest forms of animal life. There seems to be no end to the species discovered here. Every year a new section of ocean bed is explored, and a new series of animal life brought forth. The warm waters of the Gulf Stream bringing a constant supply of food and soil from the Gulf and the far interior of the west and northwest United States, makes this a rich field for the support of life. Here, too, have been discovered the breeding and hiding places of large schools of new or long-known edible fishes. One acre of land on the ocean bed touched by the Gulf Stream, is worth a hundred acres of the richest prairie land. The products of this area find their way to Chicago, and may be had at the table in a line of eating houses and dining cars as far west as Salt Lake City. Thus the soil which is lost to the West by the depredations of the Mississippi, is returning its par value with interest to the same West by aiding in the support of food fishes far out in the Atlantic.—*The Saturday Evening Herald, Chicago.*

GEOLOGY.

GEOLOGY IN GENESIS.

PROF. S. H. TROWBRIDGE.

The first chapter of Genesis—not to mention other portions of scripture—is full of geological information; and in its phraseology and general scope is not to be dispensed with in a successful study of the Earth's ancient history. It affords trustworthy data on many points of interest, concerning which, all other sources of information give us nothing but conjecture.

Geologists require a vast amount of time for a physical explanation of all the changes which have taken place in the history of our Earth. And the Bible gives it: For the "beginning" mentioned in the first verse of Genesis, may have been millions of years before the work of the six Mosaic days commenced. But in the beginning, whenever this was, "God created the Heaven and the Earth;" not as they now appear to us, but the *matter* out of which the Heaven

and Earth, or the whole material universe, were afterward to be formed. Modern scientists, in their hunger for a physical cause to every phenomenon, have studied long and hard to account for the first existence of matter and of force. Failing to find in Nature an adequate cause, they are driven to the illogical *supposition* that they never had a beginning. In Genesis we have the only information the human mind has yet acquired as to their origin. Matter was *created.*

In the second verse the Earth, "without form and void," was mixed up in confusion with the other matter destined to form our solar system. This whole mass of matter was in a dead and useless condition, and without any definite shape because it had no force of attraction or motion, no manifestation of light or heat. No force in any form had yet been caused to act upon or through matter. We know that this must have been the condition of things at that time, for we are told that "darkness was upon the face of the deep," (the "deep" here mentioned was not the deep of ocean, for water as such could not then exist, but the deep of chaos). Attractive forces, whether molar, molecular, or atomic, produce motion, motion produces heat, and cosmical heat and light are inseparable. All forms of force are transformable into light, and without these forces light is a physical impossibility. Force, like matter, is held by so-called "modern science" to be eternal, and to be an inseparable accompaniment of matter. Yet here we are taught that matter once existed without any power to attract, repel or influence other matter. It would ever have remained so, and would now relapse at once into its original chaos but for the brooding spirit of God. Force is not a property of matter but an attribute of spirit. When the "Spirit of God moved upon the face of the waters," or hovered with creative power over this unmeasured expanse of dead matter, the particles were made to attract one another and they rushed together producing an enormous conflagration. If, as the chemist asserts, the light of a common fire is due to the clashing of atoms of oxygen and carbon, and the intensity of the calcium light results from the concussion of the atoms of oxygen and hydrogen in the blowpipe, it is easy to conceive that the first collision of all the atoms in the universe would produce no ordinary illumination.

When matter became capable of attraction and motion it was for the first time prepared to obey the command: "Let there be light." Dividing the light from the darkness could not refer to the alternation of day and night due to the rotation of the Earth on its axis, though many thus explain it; for the Earth was not at this time a distinct planet but a part of the nebulous solar mass, and the Sun and Moon were not appointed to divide the day from the night till the fourth day. The term "light" is, without doubt, used here in the abstract as now separated from the darkness of all the past. The passage would, perhaps, be more correctly understood if rendered: And God called the light what we call day, or day-light, and the darkness what we call night.

This ends the first creative Day. At this point in the history of the matter of which our Earth formed a part, it had reached the condition in which the nebular hypothesis first takes it up.

The word "firmament" originally means, not something solid, but an expanse, and doubtless here refers to the open space occupied by the heavenly bodies, perhaps both in and out of the solar system. The word is evidently used in a more restricted sense in recording the work of the fourth day. There it has reference to the space occupied by the Sun and Moon; and in the fifth day, to our atmosphere in which birds and insects fly. As to what is meant by dividing "the waters from the waters," there has been much difference of opinion. While most understand by it the separation of seas from clouds by precipitation of the moisture, and the clearing up of mist in our atmosphere, the idea of Dana that then the "planets were invidualized," and of Mitchell that the matter they now contain was then collected around centers of aggregation, seem more reasonable.

The same difficulty occurs in defining satisfactorily the waters under and and above the firmament. They are commonly understood to mean respectively seas and clouds, and plausibility for this view is given in verse nine when the waters under the Heavens were gathered into one place and the dry land was made to appear. But doubtless the most satisfactory interpretation is to consider the waters under the firmament as the nebulous matter, out of which our earth was formed, separate and distinct from the other members of the solar system, and these as the waters above the firmament. For, from the conditions of the nebulous mass of dead matter uniformly diffused in space just vivified with powers of attraction and motion, and having just manifested the result of its first molecular activity in the first appearance of light. before it had contracted, before a single planet had separated from the parent mass, the transition seems too abrupt to pass all at once to the time when the Earth had already left the solar mass, had concentrated from its original ring, thrown off its Moon, contracted to its present size, and cooled till its aqueous vapor had been precipitated to its surface. Again, if the the separatiou of these waters referred to the clearing up of mists in the Earth's atmosphere, why should not the Sun and Moon have become visible at once instead of two days later? So slow a progression of events from the second to the fourth creative day seems strangely out of harmony with their rapid progression between the first and second days, of which, if the generally accepted view is correct, Moses makes no record whatever. Hence I conclude that this separation and concentration of matter so as to leave the firmament, or empty space, between the planets of the solar system, was the work of the second day.

As the statement, "God saw that it was good," concludes the record of each day's work except the second, scholars have expended much fruitless labor in their attempts to explain this omission; but as it occurs twice in the records of the third day, Patrick, Bush, and others, claim that verses nine and ten belong to the second day. This would make a more natural division of creative work,—as others without regard to this expression of approval have suggested, —and make the recorded approval of the Creator to conclude the work of each day. If we accept this division, we must add to the changes on the second day the concentration of the gaseous matter of the earth, first to the liquid form, then

to a solid till it resulted, according to the hypothesis, in the elevation of land above the ocean.

After the upheaval of the land, the next thing in natural order would be the utilizing of it, as soon as sufficiently cooled, by the growth thereon of low orders of plant-life. And Moses next records that the Earth brought forth grass, the herb yielding seed and the fruit-bearing tree, following each other in the same ascending order as determined in nature by the advanced paleobotanist. It should be noticed: 1. That the grass is not mentioned as yielding seed; it perhaps refers to sea-weeds, lichens and fungi,—the lowest of plants and the first found fossils in the rocks,—which propagate by means of spores instead of seeds; 2. that the herb is mentioned as yielding seed after his kind; and 3. that the tree is specified as yielding fruit, as if for food. Now the fact that these three groups of plants, evidently representing all the great subdivisions of the vegetable kingdom, were all created on the third day, would lead to the supposition that the work begun on the several days might be only initiatory, and might continue to unfold with higher forms of life during the succeeding days; for geology furnishes us no evidence that all these kinds of plants existed before the commencement of animal life introduced on the fifth day. In fact geology has not yet satisfactorily shown that plant remains exist in older rocks than do those of animals. Yet the presence of graphite, a pure carbon, and so far as known the result of vegetable growth, which is found in abundance in the older rocks, argues the pre-existence of rank vegetation. The presence of iron ore is also considered by some an indication of vegetable life, and iron is especially abundant in the earlier strata. The statement is common that plant remains doubtless exist in the Earth and only await future discovery. But this statement, based as it is upon our ignorance, can have but little scientific weight.

Another supposition, open to the same criticism, is that the conditions necessary for the preservation of plants were not as favorable as for the preservation of animals. This theory, however, has some plausibility because it is well known that the woody structure of plants is far more destructible than the calcareous or silicious shells of animals, and it is only these remains of animals that are usually found. Physiology teaches the priority of vegetable life, for it is essential to animal life, being its universal food. Another question that frequently arises in this connection is: How are we to account for the existence of vegetable life upon the Earth before the Sun appeared, when plants cannot grow without sunlight?

According to the nebular hypothesis, the light and heat from the *nebulous* Sun would have been sufficient to promote vegetable growth, even while it was yet so enveloped in the vapors of its own atmosphere, or concealed by the unprecipitated vapors surrounding the earth, as to be invisible. And, according to the Mosaic record, the light abstract or cosmical of the first day would be sufficient to promote vegetable growth. But it is highly probable as we shall see a little later in discussing the creative days, that, in the panorama of creation which Moses saw, his attention was not arrested by the low orders of plants

which first appeared, but what he records as the creation of the third day was the luxuriant vegetable growth of a later geologic age.

The work of the fourth day consisted in bringing into full view the two great lights understood to be our Sun and Moon. To appear with disks of distinct outline as we now see them, instead of immense masses of nebulous matter, the process of condensation must have been far advanced. Whether the work of this day resulted in far greater condensation than existed at its beginning, or simply in clearing up the mists and clouds in the Earth's atmosphere so as to reveal the Sun and Moon, seems difficult to determine. The former view would seem to make the work more in harmony with that of the other days, as regards the magnitude of results accomplished; while the latter seems more consistent with the facts as we understand them. We could not expect the Moon and Sun to arrive at the same state of condensation at the same time, for we known the Moon, on account of its small size, is now a cold inactive cinder, a "dead planet," while the Sun is still in a glowing state of igneous fusion. But it is not necessary that we should suppose the same amount of time and force to be expended in the work of each day or that the accomplished results should be of equal importance. The only essential seems to be, an event sufficiently striking and important to impress the mind of the inspired writer as one worthy of especial attention and record.

On the fifth day the *waters* were commanded to bring forth the various lower animals. "*Moving creatures*" are understood from the original to be those which rapidly multiply, probably for the most part oviparous. "Fowls" include every flying thing, insects, pterodactyls and other bird-like reptiles. "Whales" include the monstrous saurians of the Reptilian Age, and also, doubtless, sharks, crocodiles, and the like. In the order in which these are mentioned, it is not easy to trace *exact* harmony between Genesis and Geology. Fishes might answer to the moving creatures, as they are among the most productive of all animal life, one fish often depositing hundreds of thousands and even millions of eggs. But several other forms of life appear in the geological record before fishes. Radiates and Mollusks were especially abundant, and Trilobites less so. These may be included in the expression "moving creatures," as well as other peculiarly prolific animals.

As Moses notices only the most prominent points in the earth's history, the few objects he mentions are doubtless typical representatives of many others he passes over in silence. If we reason from other points in this history on which increased knowledge of nature has thrown great additional light, it is safe to infer that *when* we thoroughly understand the affinities of all the lower animals both fossil and living, and their exact relations to one another through a more careful and intelligent study of these forms; and when we have acquired a more thorough knowledge of the Scripture record itself by more profound study of shades of meaning in the original words, and more exhaustive comparison of manuscripts, not omitting, in either line of investigation, the illumination of the Holy Spirit, then we may expect to find that, for their number, the few words

Moses uses are the most comprehensive that could be found, and represent most fully the real relations existing among the lower animals.

While most of the life referred to in the creations of this day belongs to the water and is brought forth in it, this cannot be true, with our present understanding of the birds, though it may be of all other flying things. In verse twenty-one, however, the winged fowl is not included in the expression, "which the waters brought forth;" and in verse nineteen of chapter two we are told that God formed every fowl of the air, as well as every beast of the field, "out of the ground." From this it would be reasonable to conclude that the fowl of the earlier part of this day were not the same as those of the latter. If we consider the first fowl as representing pterodactyls and other bird-like reptiles, and also aquatic insects upon which these reptiles fed, and the last to be reptilian birds of the Mesozoic age, followed by real birds associated with beasts of the field, we have an order of succession exactly parallel with that which we find in the record of the rocks. Moreover, the lack of definiteness in the term fowl, and also its application to both water and land animals, may be a covert indication of the transition from reptilian to bird characteristics in the Reptilian age, as has been shown by Prof. Marsh, and others; and thus evidence the fact that the inspired Word of God, even in its secondary office as expositor of nature, is superior to the latest discoveries of modern science.

The sixth day is devoted to the creation of the highest of the lower animals and, lastly, of man. Like the plants of the third day, the lower animals of this last day are represented as brought forth from the *Earth*. These, no doubt, include the gigantic mammals of the Tertiary Age and all the quadrupeds from that time to the present. As man is the highest of mammals the physical work of this day was devoted entirely to the creation of mammals. The physical part of man, we are told in Genesis ii., 7, was formed of the dust of the ground. But there was more than a physical creation on this day; and the form of expression relating to it is entirely different. The record represents the Creator as summoning all the powers of the triune godhead in this last and crowning work of all His wondrous acts of creation. Let *us* make man in *our* image, after *our* likeness. While man's *body* was formed of the dust, and in this one thing related to the lower animals,—whether by genetic descent or by immediate creation neither Scripture nor science fully assures us,—this was not all of man. In addition to this, God breathed into his nostrils the breath of life and man became a living soul. This cannot refer to animal life of air-breathing animals, for all quadrupeds possessed this before, and the same statement is nowhere made of them. None of the beasts of the Earth, or of the cattle, or of the creeping things had *this* breath of life. They were never made to become such living immortal souls. No doubt the lower animals have *limited* thinking and reasoning powers, but they have no power of abstract reasoning and no moral sense. They were not created, as was man, in knowledge, righteousness and true holiness after the image of God. Man in the image of God is a spiritual being. God is spirit. It is this spiritual part of man which entitles him to dominion over the lower ani-

mals, many of which have bodies that far out-measure, out-weigh, and over-power his. If men should ever prove that the body of man is developed from that of some lower form of life, they would even then be far from proving a like origin for his spiritual nature; and till they have more marked success in demonstrating the former, there is little ground for fear that they will soon or ever establish the latter.

Authorities differ widely as to what particular geological formations belong to the work of each creative day.

As the plants of early geologic time were marine, and perhaps entirely submerged, it is reasonable to suppose they would not attract the notice of Moses, as the scenes were pictured before his mind's eye, with anything like the vividness of the vast forests of the Carboniferous Age which formed our coal beds thousands of square miles in extent and scores of feet in aggregate thickness. Prof. Dana estimates that "for a bed of pure anthracite thirty feet thick the bed of vegetation should have been at least 240 feet thick." If we compare this thickness with the depth of fallen and decaying vegetable matter on our oldest and densest timber-lands, we can easily imagine how much ranker must have been the vegetation of those primeval forests. If the luxuriance of this vegetable growth was what Moses referred to, the third creative day must correspond with our Carboniferous period. The excessive heat, the great amount of carbonic anhydride in the air, and the thick fogs and vapors which still concealed the Sun, were all favorable to this profuse and dense vegetation.

The first and second days would then be represented by the Archæn, or oldest rocks formed, and the Silurian and Devonian Ages following. In these strata nearly all the remains of life we find are marine and would not impress the mind of an observer. During all these ages, too, the geologic record informs us there was but little land raised above the ocean, and this little was but slightly elevated and was barren of all life but the meanest vegetable forms. At best it would have presented but a most desolate and unattractive picture to an eye-witness. But in the Carboniferous Age the land was greatly extended, and the contrast it presented to the desolation of all previous time must have been peculiarly noteworthy.

During the fourth day, while the atmosphere was being cleared of its mists and clouds so as to reveal the celestial luminaries, the submergence of this profuse vegetable deposit and its burial by the detritus of the sea under thick layers of clay and sand, such as we now find above the coal, might have been going on. Then, when the waters brought forth the swarm of monster "whales" and flying reptiles of the fifth day, would follow in geologic order the Reptilian Age which abounded in just such animals. Following these, the geologic record next discloses the crawling sloth of monstrous size and the other huge terrestrial mammals associated above with the flint implements of pre-historic man, which closely correspond with the creeping things, the cattle, and lastly man, of the sixth Mosaic day.

ANTHROPOLOGY AND ARCHÆOLOGY.

NORTH AUSTRALIAN TRIBES.

PROF. OTIS T. MASON.

Mr. E. Palmer, after having enjoyed exceptional advantages of personal observation, contributes to the Anthropological Society, of London, a paper of great merit on nine Australian tribes, living chiefly on the streams emptying into Carpentană Gulf. Tribal boundaries are known and respected, but there is no individual right of land. When tribes met at a common festival, it was with the consent of the owning tribe; they never hesitate, however, to cross a neighbor's ground for war or blood revenge. The color of the skin varies from black to light brown. The women are healthy, their children precocious. Infanticide is less common than supposed, but abortion is frequently resorted to. The men are stoical and cruel, practice polygamy, and are skilled in deceit. Mr. Palmer enters minutely into their hunting, foods, weapons, arts, ornaments, graphic methods, amusements, beliefs, myths, ceremonies, burial, and healing art.

That which will interest most highly the anthropologist is Mr. Palmer's studies in their class system. Mr. A. W. Howitt reviews his contributions, adding information from other sources so as to make the chain as complete as possible. It may not be known to all the readers of science that the Australian tribes are separated into classes, four, or some other number. The blacks are born into these divisions and they must not marry into their own class or eat the animal which represents it, indeed, they do not like to see any one else eat of their totem. A few specimens of these classes from the simplest to the more complex will illustrate the subject:

	MALE.	MARRIES.	CHILDREN ARE	TOTEMS.
DIERI TRIBE.	Kararu.	Matteri.	Matteri.	Hawk, Lizard, Emu, [Dog, etc.
	Matteri.	Karam.	Kararu.	Kangaroo, Snake, [Rat, Frog, etc.
YERRUNTHULY TRIBE.	Bunbury.	Woonco.	Coobaroo.	Brown Snake, Emu.
	Coobaroo.	Koorgielah.	Bunbury.	Carpet Snake.
	Koorgielah.	Coobaroo.	Woonco.	Whistling Duck.
	Woonco.	Bunbury.	Koorgielah.	Turkey, Native Dog.
MYCOOLON TRIBE.	Marringo.	Goothamungo.	Bathingo and Munjingo.	
	Yowingo.	Munjingo.	Jimalingo and Goothamungo.	
	Bathingo.	Carbumngo.	Marringo and Ngarran—Ngungo.	
	Jimalingo.	Ngarran–Ngungo	Yowingo and Carbumngo.	

In the Dieri Tribe it will be noticed that there are two classes, and that the children take the mother's name. Now Mr. Howitt thinks that all the tribes with four classes have each a still more fundamental division into two main classes, with father or mother right. This is substantially the plan lying at the foundation of our Indian clans. Observe now the Yerrunthuly Tribe. The children are named after their grandparents, that is, after mother's mother or father's father. This method is not found in North America. The Mycoolon Tribe exhibit a still greater differentiation. Here males and females have separate class titles. The boys are named after fathers' fathers, and the girls after their mothers' mothers.

Bearing in mind Mr. Howitt's remark upon the two fundamental, generic classes, and observing whether the boys' or the girls' names are taken from the same fundamental class, we discover that among the Mycoolon the girl is of the same class name as her mother's mother. In the Kamilaroi system, with mother-right, the son is of the same class as his father's father. In other words, says Mr. Howitt, in the Kamilaroi system descent is uterine; in the Mycoolon, it is agnatic. As Mr. Dorsey has shown us that, among our own Indians, the law requiring a youth to marry out of his clan has many addenda, pointing out whom the bride shall be; so among the Australians, it is not quite true that any Koorgielah may marry any Coobaroo. We have primary class, and secondary class, and, in addition, totems. Mr. Wm. H. Flower has been able to give us a table illustrating this in the Kuin-Murbura Tribe:

MALE.	MARRIES.	CHILDREN ARE.
Kurpal—eagle-hawk.	Karilburan—hawk.	Munal—hawk.
Kurpal—laughing-jackass.	Karilburan—curlew.	Munal—curlew.
Kuialla—eagle-hawk.	Munalan—hawk.	Karilbura—hawk.
Kuialla—laughing jackass.	Munalan—curlew [ass.	Karilbura—curlew.
Karilbura—curlew.	Kurpalan—laughing jack-	Kuialla—laughing-jackass
Karilbura—clear water.	Kurpalan—eagle-hawk.	Kuialla—eagle hawk.
Karilbura—wallaby.	Kurpalan—laughing-jack- [ass.	Kuialla—laughing-jackass
Karilbura—hawk.	Kurpalan—eagle-hawk.	Kuialla—eagle hawk.
Munal—curlew.	Kuiallan—laughing-jack- [ass.	Kurpal—laughing jackass.
Munal—clear water.	Kuiallan—eagle-hawk.	Kurpal—eagle-hawk.
Munal—wallaby.	Kuiallan—laughing-jack- [ass.	Kurpal—laughing-jackass.
Munal—hawk.	Kuiallan—eagle-hawk.	Kurpal—eagle-hawk.

In this scheme the law of naming is the same in essence, but is more complex. In the Karilbura and Munal there are two female totems and four male totems; while the Kurpal and Kuialla have two male and four female totems. In the subclasses, a modified form of uterine descent is followed in the totems, the line runs as in the primary classes.

Mr. Palmer devotes a large space to the Australian languages, giving vocabularies of seven.

A chapter of great value to the anthropologist is that upon the plants used by the natives of Mitchell and Fluiders Rivers for food, medicine, stupefying fish, weapons, and manufactures, 104 species in all. Once in a while a report of this kind is made, and it always arrests attention. Just about the time Sir John Lubbock's discussions upon the amount of land necessary to support a savage were becoming well known, our own Government-surveying parties began to send to the National Museum specimens of all the foods used by our aborigines. No one can look at the long rows of jars containing these foods without realizing that the great Englishman left out a large factor in his problem. The same fact appears from Mr. Palmer's lists. The Australians eat roots, bulbs, root-stalks, stems, leaves, stalks of flowers, buds, skins of stems, fruits in endless variety, and seeds. They eat some of them raw; others roasted, steamed, or macerated; and poisonous plants are subjected to a series of soaking, steeping, mashing, roasting, grinding, and baking that completely destroys the noxious quality and furnishes a wholesome food. Five of the plants named are used to sicken fish. Those set down as medicines are used as veritable drugs and not as sorcerer's charms. The list includes crushed leaves, bark, and flowers, soaked or steeped, and applied externally for a poultice or bathing, or the water is drunk. The *Eucalyptus pruinosa* bark is bruised and wound tightly around the chest, being kept damp with water. The patient also sits in a decoction of the plant. The young black fellows rub their faces with *Drosera indica* to make their whiskers grow. Eighteen plants are mentioned as furnishing material for cordage, cloth, nets, boomerangs, reed spears, shields, etc.

DR. SCHLIEMANN: HIS LIFE AND WORK.

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He has again visited the Troad; he has again hired laborers, and lived in tents, and brought with him great experts, in order to clear up and verify what remained obscure and doubtful in his former investigations. The main difficulty in his mind was the apparent smallness of the early city which he found to have been burned, and which seemed certainly the city which gave a basis and a local habitation to the traditions embodied in the Iliad. The gold found there implied considerable wealth; all the legends pointed to the spot having once been occupied by a powerful and civilized people, and yet there seemed no room for them. His new book gives us the natural solution. He had mistaken the acropolis of the "second city" for the whole of it. His architects proved to them that there had been an extensive lower city around the "Pergama of Priam," which was also burned in the great catastrophe, but was not resettled or built on again. From that time small and obscure descendants occupied the royal site, and left poor and shabby traces of their life. It was not till the successors of Alexander enlarged and beautified the town, and the Romans, with

the sentimentality of vulgar upstarts, began to parade Ilium as the home of their ancestors, that another important town marked the persistent site.

Moreover, he had also failed to distinguish clearly the second and third layers of remains on this ever re-established site, for the settlers who came after the great conflagration did not level more than they wanted, and the old buildings here and there reach up through the stratum produced by the third settlement. Again, what he calls the sixth city was not marked by a layer of soil, but only by a large assortment of very peculiar non-Hellenic pottery, which he had called Lydian, but which he now declines to call by any name, while insisting upon the fact of its presence and peculiar character. The outcome of his long labor is, therefore, briefly this: on the site of Hissarlik, and there only in the Troad, there are piled up one upon the other a great series of human traces, reaching from the most remote antiquity into the decline of the Roman Empire. These human traces were separated into periods, in that each of them is covered by a more or less distinct layer of earth and ashes, upon which the next is laid. There are at least six of these layers; and what is most important and remarkable, only the topmost (sixth or seventh) is of what we call a historical character. It alone shows the distinctly Hellenic character in both its pottery, its utensils, and its buildings, and reaches a very little way (not more than six feet) into the earth. Nevertheless, we know that a small Greek town existed there for at least six centuries before Christ. If, then, the remains of such antiquity reach down to only six feet under-ground, what shall we say of the antiquity of the older settlements, which are to be traced down to fifty-two feet under the present level? The mind recoils somewhat aghast from so gigantic a computation. But the character of these older remains corroborates our conclusion. They all bear a distinctly prehistoric character. There is no trace of coinage, of writing, of painting on terra cotta, nay, in the deepest layers even the potter's wheel seems hardly known, and the wares are of the rudest hand-made description. The closer details as to these successive layers of pottery are very clearly given in a remarkable letter from Rudolph Virchow—a European name—and printed (pp. 376 *et seq.*) in the new volume. He there shows "that there is no place in Europe known which could be put in direct connection with any one of the lower six cities of Hissarlik." And again, after describing the character of archaic Greek pottery, he adds: "Seeing, then, that this highly characteristic archaic pottery is totally absent in the deeper strata in Hissarlik, we are at a loss to discover what in all the world is to be called Greek in them. With equal truth might many kinds of vases from Mexico and Yucatan, nay, even from the river Amazon, be called Greek." This is in answer to the ignorant people who attempt to assign late historical dates to all the successive settlements, save one. The non-Hellenic, if not pre-historic, character of these rude wares is singularly illustrated by comparing them with the oldest pottery our author found at Mycenæ. In the latter, though there can be little doubt that their date is not later than ten centuries before Christ, we find the unmistakable character of Hellenic work. They are the direct ancestors of the splendid vases imported to

Italy, and copied in Etruria. This fact in itself makes all skepticism as to the antiquity of the remains at Hissarlik impossible, except on grounds of ignorance. We have heard in our own day of respectable scholars who are still skeptical about the deciphering of the Egyptian hieroglyphics, and the cuneiform writings of Asia. It is quite useless arguing with such people. All one can do is to beseech them to examine the evidence without prejudice, and to examine the evidence they must, of course, learn something of the subject in hand. It is not enough to have read Homer, or Curtius's *History of Greece*, or to have gone to the Troad as a tourist, and to have seen the place. Archæology is a special study, infested no doubt by amateurs, but requiring honest and serious attention.

The demonstration that there existed on the site always recognized in class-days as the site of Troy, a very ancient and important city, with a citadel and such wealth that considerable remnants of gold were lost or forgotten in its ruins —a city, moreover, destroyed by a great catastrophe, and burned with fire in such a way as to preclude all accidental misfortune—makes it almost certain that the poet or poets of the Iliad, whatever historical basis their story may have, certainly attached their stories to this site, and that the memory of this great conflagration had, in some way, survived up to the time when the Iliad was composed. This, again, forces us to place the origin of this epic poetry, at least of the shorter and ruder attempts which preceded the Iliad, at an early date. The brilliant theory of August Fick, that these poems were first composed in the Æolic dialect, and then imperfectly recast in Ionic, falls in with the same argument. But we must not enter into learned discussions in this paper. It is right merely to allude to these literary and historical questions to show how important is the light thrown by Dr. Schliemann's excavations on questions which have hitherto been disputed on purely bookish grounds. Those who wish to have a large and clear view of the general course of enlightenment which our early history of Greece and Asia Minor has undergone from archæological sources, will turn to the brilliant preface with which Professor Sayce has introduced Dr. Schliemann's new volume, *Troja*.

We have often tried to induce Dr. Schliemann to dig on Hellenic sites, but his proper task and the general direction of his studies is to investigate pre-historic antiquity. For this purpose he has not only made his magnificent venture at Mycenæ, of which the results are recorded in a special work, and exhibited in the splendid collection of gold and silver ornaments now at Athens; he has also investigated the alleged home of Ulysses in Ithaca, the great tomb-measure-house of the legendary kings at Orchomenus, and some other less important sites. These researches have conspired with sundry discoveries of pre-historic tombs in Attica, and of archaic art about Sparta, in modifying considerably the current notions of early Greek art and its development. This is the most important outcome of Dr. Schliemann's work, and that to which we desire to call special attention. It used to be a favorite theory among scholars, and is no doubt very common among those who confine themselves to a grammatical study of Greek texts, that the Hellenic race was perfectly original in its art, that the

peculiar character of their architecture and sculpture, and painting was their own invention, and due to no foreign source. The old legends of Cadmus and Agenor and Danaus bringing the arts from the east to the south were rejected, and Greek art was considered to be purely *autochthonous*, as the scholars were pleased to disguise the term indigenous.

What has been now found to be the real state of the case? The historical Greeks have been everywhere preceded either by Greek ancestors, or by some kindred race who possessed both wealth and ingenuity, and had advanced no small distance both in the useful and the ornamental arts of life. Let us take, for example, the great stone buildings of Mycenæ. Here we find enormous stones squared, or even shaped into curves, so as to form the inner surface, perfectly regular, of a great bee-hive vault. We find heraldic sculpture used over their gates, and such massive defenses as must have mocked any assailant of those days. When Dr. Schliemann found the royal tomb within these walls, he found a vast store of ornaments, and vessels not only beautiful in shape, but delicately and gracefully ornamented, while the sculptures on stone and the gold masks on the faces of the dead were rude and ugly in the extreme. The general character of these ornaments could not be called Greek; it was strictly pre-historic, barbarous, if you please; nor could it be called Oriental; but there were not wanting traces of Oriental influence and cases of Oriental (including Egyptian) manufacture. A portion of an ostrich egg proved beyond doubt the existence of a trade with Africa. Engraved gems of strange designs pointed unmistakably to similar Babylonian or Hittite ornaments. And if we had fuller knowledge of the early art of Asia Minor, there can be no doubt that we should find the Mycenæan art was more imported than original. Not that we mean to deny the originality of the Greeks. We desire rather to correct the meaning attached to the word originality, and insist that in both art and literature pure invention is both rare and unsuccessful, and that true greatness consists in the genius of adapting and perfecting the forms or ideas handed down from earlier minds. There are some productions in which perfection of form was very early attained. The earliest and rudest pots are generally very ugly and clumsy imitations of a female human figure, sometimes of birds or beasts, and so long as this fashion persisted, no beauty was attained. But no sooner was this idea abandoned, and mere curves studied with the aid of the wheel, than we find shapes as graceful as any that can be designed in the present day—nay, superior to most of them. This is very remarkable in the gold jugs found at Mycenæ, and which, though of very perfect workmanship, are undoubtedly of great antiquity. And here not only the shape, but the decoration of the surface, is both ingenious and beautiful. In terra cotta ware the surface decoration was slower in coming to perfection, but the shapes of many of the vessels found in pre-historic sites are not to be excelled. There was one vessel found at Mycenæ made of some kind of alabaster, and probably imported from Egypt, which at first sight looked for all the world like a Renaissance vase, the rim being actually a waved circle. The reader must go back to the earlier *Ilios* and *Mycenæ* of Dr. Schliemann for examples to

verify our statements. All his former researches at Hissarlik, and even his last visit and further excavations, did not, however, satisfy the indefatigable man, who undertook in May, 1881, a journey through the Troad, very graphically told (pp. 303-348) in his *Troja*. He wished to see whether there were any other prehistoric sites worth excavating, and also what could be made out about the geography of the country as described by Strabo. But, all through, the keen interest of the traveller, loving to talk with and understand the natives, and enthusiastic at the sight of natural beauty, gives life and beauty to the narrative.

* * * The example of Dr. Schliemann ought to lead the way to similar enterprises. Already the Dilettanti Society have added to the glories of England by their costly and conscientious publications of Greek antiquities; already the German government has shown what can be done with a very moderate outlay, intelligently directed, at Olympia, and still later at Pergamus. Let us hope that among the many men who have inherited fortunes far beyond the requirements even of luxury, some will apply their wealth to this very noble end.

For a noble end it is to inquire into the rudest remains of long-departed races, and to inquire not by theory and conjecture, but by an examination of actual facts. The pure savage attends only to the wants and pleasures of the day, and when the sun sets, has no desire but to sleep. The higher men rise out of this condition, the wider their sympathy with remote and bygone members of their race, the more do they prolong into the night the interests and pursuits of the day. This it is which has ennobled civilized man; this it is which has given dignity to the poorest and narrowest conditions of life.

But now that he has been advised to abandon his arduous labor and devote his remaining years to a better care of his delicate health, he can look back on all these distinctions as only the index of his real desert—that of having added permanently to human knowledge. What a cloud of conjecture and hypothesis has he removed from both Troy and Mycenæ? For if his discoveries have in turn given rise to many controversies, they are controversies about the interpretation of facts, not about the respective probability of rival theories. He has proved what modern skeptics were coming boldly to deny, that the old legends of the Greeks had a local attachment, and were based upon facts in past history. He showed that the sites of cities are permanent things, which men will not surrender even after violent catastrophes, and that we may always seek the old under the new. The growth of legends about tombs of great men is particularly interesting, for it can be paralleled in the legendary history of other and distinct branches of the Aryan race. Above all, he has added a great store of facts for the comparative study of pre-historic man in the south of Europe. We are now beginning to see the general features in the industry and the ornaments of primitive men, and the curious truth that the pottery in all the pre-historic strata at Troy, up to the verge of the Greek remains, is perhaps less like these remains than it is to the pre-historic pottery of Italy, Germany, or even Peru, shows that we may yet attain to a general view of the state of man under certain conditions of life.—*Harper's Monthly for May.*

METEOROLOGY.

BIRTH OF THE TORNADO.

CAPTAIN SILAS BENT.

The prevailing winds of the Basin of the Mississippi are from the westward; being from the northwest in winter and from the southwest in summer.

The westerly winds are cold, dry and compact, or heavy; whilst the southerly winds—especially if coming from the Gulf of Mexico—are warm, moist and diffuse, or light.

This marked meteorological difference in these winds, forbids their ready or fluent commingling, but on the contrary, in fact, rather establishes a vital antagonism, between them, which leads to dire conflicts for supremacy wherever they encounter each other during the transition seasons of spring and autumn; at which times, the atmospheric convulsions are often so great as to culminate in most destructive storms.

When these encounters take place, the north wind, owing to its greater specific gravity, wedges under, or under-runs the lighter south wind and is thus placed between the warm earth below and the still warmer south wind above, and feeling the impulse of its increasing temperature, begins to expand, but being still pressed onward by its own volume in the rear and finding no escape, its travail begins.

Meanwhile, its own chilling effect upon the humid atmosphere above condenses and wrings out from the latter, torrents of rain. This rain in turn, however, is not unfrequently converted into heavy hailstorms before it reaches the earth, by the rapid evaporations to which it is exposed in passing through the cold, dry stratum of north wind beneath.

The struggle thus begun, continues until the underlying cold wind finds a weak spot in the stratum above, through which it makes a breach and bursts forth with an upward force, proportioned to the pressure it is sustaining.

An opening once made, the rush of the surrounding air towards the central outlet—obedient to physical law—assumes a rotary and upward whirl, the vortex of which is a vacuum, but whose substance becomes a writhing column of wind, water and electric fire; with its base resting upon the earth, but whose summit reaches above the contending winds; and the TORNADO has sprung into existence, ready to start on its brief but terrible career of destruction and death!

In addition to this whirling movement—the velocity of which is beyond computation—the tornado at once takes place on an onward or progressive motion over the earth's surface, whose path is probably the resultant of the relative

strength and directions at their impact, of the original winds to which the tornado owes its genesis, and which path it pursues until the equilibrium of the atmosphere is restored.

ST. LOUIS, MO., April 12, 1884.

METEOROLOGY REVOLUTIONIZED BY THE WEATHER-MAP.

ISAAC P. NOYES.

No department of Science was ever revolutionized to a greater extent, by any one step, than was meteorology by the Weather-Map.

Prior to the discovery of the Western Hemisphere the world knew little about the geography of the globe. Till science had advanced and given us the telegraph and all the details necessary for the complete Weather-Map we knew comparatively little about meteorology.

At first it may seem strange that such should be the case, yet the intelligent world will admit that we cannot know much about any subject until we have full and complete facts, and that meteorology is no exception to the rule.

The Weather-Map opened a new field, replete with facts, which all these years were unknown to us.

In order to have a Weather-Map of any value, we must not only have an extended territory, but that territory must be under the jurisdiction of one central head. In this respect the United States is particularly fortunate. Three times daily, at 7 A. M. and 3 and 11 P. M., the reports are sent in from all parts of our extended country to the central office at Washington. From data thus collected, the daily Weather-Map is created and the "indications," daily, morning and evening, telegraphed to the press of our cities and towns.

Prior to the advent of this Map we were dependent upon the branch of science known as "physical geography" for our knowledge of meteorology; now the fact is revealed to us that the old system could give us but little practical information. We will not however complain of this old system, or its teachings, prior, say to 1875, or before the Map had become the perfect thing that it is to-day; but from 1875 on, to date, it is surprising that the new system has been so much neglected.

Although the Map, in the United States, was established about 1870, its first editions were quite crude and it necessarily took a number of years to arrive at the perfect work of to day. Some may think the progress slow, but when we come to consider the difficulties in the way, the little moral support this institution has received from the public and the general lack of interest whereby generous appropriations become practical and available, the wonder is that the subject has been advanced even to its present condition.

In the old system there was necessarily too much dependence upon the deductive principle; in the new we have a fine illustration of the inductive prin-

ciple. In the topography of the country we have the hill and valley. Although these combinations form only two factors the diversity of landscape which they produce is infinite.

The atmospheric counterpart of the hill and valley is high and low barometer—technically called "High" and "Low." These terms the reader should bear in mind. "Barometer" is a long word, so in the phraseology of the Weather-Bureau it is dropped, and the words "High" and "Low" respectively stand for high and low barometer.

The terrestrial hill and valley are quite permanent—as a mass they may be said to be permanent. The mountain chains and hills and the valleys remain about as they were when man first inhabited the earth; but not so with the atmospheric hill and valley. They are ever changing; never twice alike. They are as varied as the clouds, and in their variety they more resemble the kaleidoscope than anything else. These changes, from hour to hour, day to day, produce what we term "the weather." They are ever on the move, on general lines, from the west towards the east. We live on a globe; the heat which sustains life thereon comes from the Sun, but this heat alone will not sustain life. The body that receives the benefit of this heat must be in condition to appropriate it to a good advantage. Satellites have not this power or quality—planets have. Through the Weather-Map we are enabled to understand the important part heat plays in the economy of Nature as never before. From the old system we learned about the seasons and their general cause, but before the advent of the Map it was impossible to explain these peculiar lines of heat and cold which are independent of latitude and of the position of the sun in the ecliptic. We could not explain why the isothermal lines at times run from the extreme northeast to the southwest, or from the southeast to the northwest. Why it was sometimes as warm in New England as in the cotton States. Why cold in New England while it was very warm in the region of Dakota and Montana. Why some localities at times suffer from drouth while others are abundantly supplied with moisture.

Under the old system they even did not know what a storm was; they had no conception of storm centres and where one storm began and another ended.

If it rained two or three weeks in succession it was thought to be one protracted storm, while on the contrary it was the result of a series of storm centres passing over the country. Neither could the old system explain the tornado, hurricane, or cyclone, call it what we will. It could not satisfactorily explain numerous phenomena connected with this department of nature—all for the simple reason that the facts which the Weather-Map has revealed to us were then inaccessable. If we will heed the teachings of this wonderful instrument, which may well be termed "The Geography of the Atmosphere," we will understand this department of Nature as never before.

The Map reveals the fact that the areas of high and low barometer are al the while passing over the earth's surface, in belts and on general lines, from the west towards the east. From this it must not be understood that they move on parallels of latitude, nor even take quite straight courses across the country, for

they do not; on the contrary they move on very irregular lines, and at times take a direction of 45° and even 90° to the parallel of latitude. Sometimes taking a northeast or a southeast course, zigzag, like the letter W; and they even at times travel due west. But whatever their local direction; their *general course* is the while from the west toward the east, or towards the rising Sun. The changes are infinite: "Low" being the governing factor, it is necessarily the one about which the most may be said. It may be asked,—What is "Low"?

There is no branch of science but what leads up to some unknown power or cause. In meteorology "Low" is the great unknown. We know that it exists. We know how it passes over the country, and know its effects. But why should it obey the law it does? At this point I shall submit a theory, the only theory about the whole subject. I do not claim for it more than its name implies, "a theory," and I have no desire to hold to it if unsupported by reason and fact, and am ready at any time to accept a better reason or explanation whenever offered.

"Low" is the concentration of the Sun's rays, and may well be illustrated by the double convex lens, commonly called a "Sun-glass," when passed over a paper and so held as to focus the rays of the Sun. We will the better understand the theory by imagining ourselves to be present when the well formed earth is started in space.

The surface of the earth is varied. This feature necessarily causes unevenness of latent forces when the heat of the Sun is caused to concentrate on some one favored point. The heat acting on the water is the while forming clouds. The concentration of heat causes rarification of the air at this point—Nature's attempt to form a vacuum. The cooler surrounding air rushes in to fill the place of the rarified air; a current of air, called wind, towards this point, is the result. This brings the clouds that have formed, from all points of the compass, towards this center. These clouds not only precipitate and thereby help cool the surrounding air, but they shut off the heat from the Sun. The heat from the Sun then concentrates on another point a thousand or two thousand miles distant, and the same result follows—around the world. The next day when the Sun reappears in the east the first "Low" is drawn towards the new, or last one, which relatively lies to the east—call it No. 12. No. 2 is drawn towards No. 1; No. 3 to No. 2, etc. Thus the "Lows" travel till they form well established belts around the world. Between the "Lows" are located the "Highs."

If "Low" is the concentration of heat and thus moves along the earth's surface, the question may be asked, why does it not, after mid-day, travel towards the west? It does at times, and is at all times undoubtedly retarded in its course towards the east. Whether this theory is true or not we cannot deny the fact that "Low" travels as it does, on general lines, from the west towards the east or towards the rising Sun.

The surface movement of the wind is towards this center. But as the winds coming from the four points of the compass react upon each other, their direc-

tion, as they near the centre, is that of a spiral curve rather than a straight line. The heated air at the centre of "Low" ascends in a like manner as boiling water. The clouds brought by the winds generally precipitate before they reach the centre, but not always.

At times when a storm-centre is near us, yet not as near but what the clouds are a little broken, if we will look heavenward we will see other lighter clouds travelling in an opposite direction from those near the surface. These upper currents are caused by the ascending currents at "Low," rushing outward to fill the space on the upper part of the column of air in the regions of "High." So we have "Low" moving in great horizontal circles along the earth's surface, and in combination therewith the atmosphere moving in great perpendicular—hoop-like—circles towards the track of these horizontal circles.

The air from the bottom of "High" is being drawn from to supply "Low," when it ascends and travels back to supply the top of the column "High," from whence it was drawn. Thus the round of motion of the atmosphere, and thus Nature's plan to keep the air we breath in healthy activity. Man in his small way can never hope to equal this grand plan of Nature.

If we were unacquainted with the peculiarities of Nature we would be apt to think that the nearer we were to the equator the warmer it would always be. It is generally warmer, that is, the general heat of the tropics is greater than that of the temperate zones, and yet we know that it is oftentimes hotter from 45° to 50° N. Latitude than at or near the Equator. Before we had the perfected Weather-Map this phenomenon could not have been explained, but now we not only can readily explain it but we can the better understand the infinite wisdom in having it so.

The Earth is far more productive in consequence of the laws that govern the concentration of the heat of the Sun, causing "Low" to frequently travel on very high lines of latitude, whereby the necessary heat for the propagation of plants, vegetables and fruits, essential for the existence of high animal life is extended so far from the Equator.

There are portions of our earth's surface which never receive any benefits from "Low," and these are desert places where there is no water present. There is no heat in the earth, at least along its surface; all the heat we have we derive from the Sun. Desert places during the day are heated more readily and to a greater degree than where there is an abundance of water present, but they become very cold during the night. Between sunset and sunrise they lose the greater portion of the heat they have received during the day. Wherever there is water sufficient to generate clouds a more even temperature will be maintained than where there is no water. "Low" will not stop over night where there is no moisture. The clouds, including all moisture in the air, act as a canopy, or an agent to retain the heat, so in order to convert a desert into a fruitful country, one that will be visited by "Low," we must introduce water in some way, sufficient at least to grow hardy trees and shrubs.

The Map proves that the winds blow in general lines towards the "Low."

This being the case it necessarily follows that if "Low" is on a high line of latitude, say 45° to 50° N., we will have south winds, which are warm. If "Low" is on a low line, say in the Cotton States, to the north thereof we will have cold north winds. "High" representing the atmospheric hill, there is no movement of air towards it; so no warm air, or more than relatively warm, can be present in the area of "High" and the atmosphere there must necessarily be relatively cool.

It will be seen that what warm "the wind," and the movement of "Low," which produces the winds, are quite different forces; yet it is often asked if the speed of "Low" is caused by the power of wind. The wind is dependent upon "Low" and not "Low" upon the wind.

Although "High" follows and surrounds "Low" it does not do so in any regular manner. Nature in this department is very irregular, and the Weather-Map which is, as it were, a photograph of these changes of the atmosphere from hour to hour, plainly reveals this, and shows that "High" follows and moves with "Low" over the country; entering *generally* at the west, locally from the south to the extreme northwest, and that the two pass over the country in all conceivable shapes and on all sorts of lines.

We may imagine the whole of the atmosphere as a great sea of "High" with the valley "Low" moving through it. Sometimes alternate areas of "Low" and "High" pass from the west towards the east; sometimes the "High" will be in the north, the "Low" in the south; the "High" in the south and "Low" in the north, or additional variety be given by combinations of these factors. Then this variety is still increased by their size, shape and speed as they pass across the country.

When we have made ourselves familiar with these forces and their movements we will be prepared to understand the peculiar features of the weather—why it is hot at the north while cool at the south—why one season is cool, wet or dry, another hot and dry, or even wet; no matter what the weather may be, the Map satisfactorily explains it all.

"High" and "Low" travel in irregular belts. At times we will have "Low" in the north; "High" central, and another belt of "Low" to the south. This neutralizes the effects of heat and cold. Take away the north "Low" and it will be very cold in the south, and in winter, the Gulf States be apt to have a snow-storm; take away the south "Low" and it will be very warm throughout the country. During the winter and spring we generally have more south "Lows," and "Lows" which travel from the southwest to the northeast, than in the summer. But there is no regularity about it. A so-called "northeast storm" is the result of a southwest "Low," or an area of low barometer advancing from the southwest.

When a storm-centre is to the west of a locality that locality will have an easterly wind, and when the centre has passed to the east a westerly wind will follow in its track, west, southwest, or northwest, depending on the line on which the "Low" is travelling.

Whether the storm produces rain or snow depends somewhat on the season, but more especially on the latitude of "Low."

Local storms comes from the confines, or outer lines of the passing "Low," and mostly occur during the warmer month when "Low" is on a high line of latitude, or when there is not any very well-defined centre. A tornado is a severe local storm which occurs in the track of "Low" and generally when "Low" is on a high line, or passing to a high line.

It would require too much space to enumerate all the changes. A close observation of the Weather-Map for a season will explain all. When we have become familiar with this map we will readily see the absurdity of the statements made by the so-called "weather-prophets." They often say "it will be pleasant or stormy." "When?" is the pertinent question, for we see that it all depends upon the location and relation of these two factors "High" and "Low." It may be very stormy weather in one section and not in the other. Until the "weather-prophet" can locate his storms and give us the positions of "High" and "Low" he had better remain silent; and if he remains silent till then, he will be forever a silent man.

At present the territory from Nebraska to the Atlantic Coast is well supplied with stations, but from there to the Pacific we have very few, and these far apart. As most of our storms come from the west it would be a great advantage to us to have more stations in this locality; not only due west but well to the southwest and to the northwest, from Lower California to the British Possessions.

A few storms come from the south. We should, therefore, be prepared to have ample warning in regard to them, and have stations through Mexico and one or two sea-stations in the Gulf of Mexico, and a few more on the West India Islands. We need protection from the west generally; that is, give the most generous interpretation to the term *west*, for these storm-centres as they pass around the world are liable to travel, as we often see them in the United States for a distance of 1,000 or 1,500 miles due north. We should be prepared against these erratic or occasional ones as well as against those of a more regular course which enter our territory by the regular west-gate.

Most of the "Lows" that pass over the United States pass to the northeast, either through the St. Lawrence Valley, or somewhere between there and Cape Hatteras; hence the prevalence of fog and stormy weather off this northeast coast.

More interest should be centered on this subject. When this is done it will not be difficult to obtain more stations in the localities where they are so much needed.

There is a bright day ahead for this despised branch of science, and when it arrives our Weather Bureau will become one of the most influential branches of government, and one we will support in the most effectual manner, because of the practical benefits we will derive from its more perfect state. The Map will open to us new avenues of pleasure and interest; and when its beauties and prac-

tical value are fully understood we will begin to realize the revolution it has wrought.

WASHINGTON, D. C., April 2, 1884.

A REMARKABLE HAILSTORM.

S. A. MAXWELL.

At 9 o'clock on April 1st, a hailstorm visited this section, so remarkable in some respects that I thought a short description of it would be of interest to the readers of the REVIEW.

The preceding day had been remarkable for a rise in temperature from 38° in the morning to 64° at 3 o'clock P. M. At 9 P. M. the temperature was 54°. The wind on the morning of the 31st was from the east, but at 9 o'clock it changed to the south, from which direction it blew quite briskly all day.

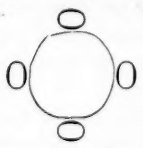
Early on the morning of the 1st there was a light shower with east wind. This was followed by a fog and light sprinkles of rain until 8:50 A. M., when the clouds became so dense that it was difficult to read ordinary print on account of darkness. At just 9 o'clock rain began to fall and five minutes later the hail was first noticed.

The largest stones were three and a half inches in circumference, and their shapes were so varied and extraordinary that the storm must certainly be called the most wonderful ever occurring here.

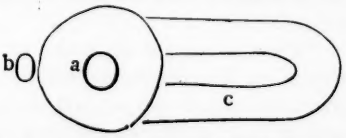
First, there was the ordinary spherical form,—some of these being entirely transparent, and others containing masses of snow at the centre.

Secondly, the lens-shaped stones, some nucleated and others not.

Thirdly, what I would call the *condyloid* form, since it resembled a button. It would have been lens-shaped but for two circular creases on the opposite sides. Outside of the crease the stone was of unequal transparency, lines of white seeming to diverge from the crease to the circumference; but when these were looked at edgewise they were seen to be circular. The following diagram



illustrates the form of a fourth variety. This is but a modification of number two, the lens-form. Number five was the most remarkable of all, and if any scientist can account for its form I would be pleased to hear from him. It is a modification of the so-called condyloid form, and this very accurately represents the form of about one-tenth of the large stones that fell here during the storm.



The part marked "a" was usually one inch across, one-third of an inch thick and usually with a nucleus of snow. "b" is a small, thin appendage, while directly opposite was a curious plate of ice "c" one-

fourth of an inch thick, the margin (being marked with lines as above described), resembling a horseshoe. The center of this part was thinner and transparent.

Of eighteen large stones picked up, two were spherical, thirteen lens-shaped, two with horseshoe attachment and one like number four, which might be called the *crucial* form. Of these eighteen hail-stones only seven had nuclei. Some of them also had a peculiar roughness, comparable to that on the rind of an orange, which I think I have never observed before.

More than an hour has now passed since the storm ceased, yet from my window I can still see a few of the hail-stones that have been diminished to the size of a pea by a temperature of forty nine degrees.

MORRISON, ILL., April 1, 1884.

RUSSIAN FRUITS FOR AMERICAN PRAIRIES.

PROF. A. E. POPENOE.

A bulletin lately received from the Iowa State Agricultural College is occupied by the account of Professor Budd's "Experiments with, and Investigation of, the Fruits, Trees and Shrubs of the North of Europe." In the search for varieties of fruits adapted to the trying extremes of climate met in Iowa, Professor Budd was led, several years since, to look to the north of Europe for varieties not then on our list, in hope that they would prove better adapted to the needs of the northwestern horticulturist than the fruits originating in the moist equable climate of the countries along the western European coast, the latter sorts having been found wanting when subject to the severe tests of the Iowa winters and summers. In company with Mr. Charles Gibb, of Abbottsford, Quebec, Professor Budd visited the interior of Russia at points where fruit-growing was extensively and profitably engaged in, and in climates resembling, in high, dry winds and changes to the extremes of temperature, those of the northwestern states in the Mississippi Valley. Portions of the reports of these two horticulturists are of such interest to the Kansas fruit-grower that they may be here quoted. "The east European plain, the counterpart of our western prairies and plains, covers the larger portion of continental Europe, or the northeast. * * With the Caucasus and Carpathian mountains on the south, the prevailing winds prevent the moisture of the Caspian and Black seas from benefiting even the provinces nearly adjoining them; while the dry winds of the deserts and sterile steppes of the southeast shrivel the foliage of trees and plants in Central Russia, as do our southwest winds from the dry plains of New Mexico. * * As to sudden changes of temperature and humidity of air, our one summer's experience favored the idea that changes of the wind brought atmospheric changes as sudden and complete as with us. As to winter changes, we are told at Tula of a winter, twelve years ago, when a warm, south-

east wind, taking off all the snow, was followed by a northern down-pour, running the thermometer down to forty-five degrees below zero."

In the province of Kazan, on the upper waters of the Volga, and about 430 miles east of Moscow, the peasantry and some landed proprietors are largely engaged in apple-growing. An orchard thirty years of age is described as consisting of six varieties, fall and winter sorts, fourten feet apart, and standing not over fifteen feet in height, the largest measuring only five inches in diameter. The conclusion was reached by the observations made in the province named, that the varieties there so largely cultivated will be found profitable in Dakota and Minnesota. In Simbirsk, where "every available spot is planted with apple, pear, plum, and cherry trees, the summer air is as dry and hot during the day as that of Iowa. The extreme winters, which come as with us at intervals of from six to eight years, are colder than in any part of Minnesota," the temperature of fifty below having been experienced in 1877.

Orchards of 12,000 trees, ninety per cent of them winter varieties, are found at Saratov, and Professor Budd remarks with surprise the systematic management of the orchards, as well as the large, fine-looking fruit produced by them. He states in seasons of unusual drouth the orchards are watered to carry the fruit to maturity. Irrigation is here managed by flowing the water in wooden troughs, supplied by a large reservoir, to basins at the foot of each tree. These reservoirs are kept filled by steam pumps. Worthy of special note was found the system of forestry under the control of the government, the plantations of trees ranging in size from 18,000 to 21,000 acres each, under the oversight of trained foresters, and consisting of Scotch pine, oak, birch, basswood, or elm, in separate tracts, mixed planting not being favorably regarded.

Concerning the much lauded Russian mulberry, it is said to kill back in severe winters, and reports of its use in Russia as a timber-tree are without foundation, unless in the extreme south. Apples were found which were compared by the observers named to our Grimes' Golden, Dominie, White Winter Pearmain, Limber Twig, and other standard sorts, but of better keeping quality and greater vigor of constitution; pears of good quality, perfectly hardy, and, as Professor Budd thinks, capable of resisting blight more or less fully; cherries and plums of superior quality and of great hardiness; and many beautiful and hardy additions to our ornamental trees and shrubs, as well as to the list of profitable trees for forest-planting on our western plains. In a letter to the writer, Professor Budd says: "Our work is not confined to the far northern fruits. The idea is to get the fruits, shrubs, and plants of those portions of Europe with dry, hot summers, and cold winters. Boiken apple, Batullen apple, Bauman's Reinette, etc., Sapieganka pear, and very many other things we grow, are just what Kansas needs. So in the peach line."

Of all these sorts, scions or seeds were secured, and are now in process of trial on the grounds of the Iowa College; and their early dissemination among the intelligent horticulturists of the Northwest will soon show how valuable they are, and how fully the enthusiasm of Mr. Budd is warranted.

REPORT FROM OBSERVATIONS TAKEN AT CENTRAL STATION, WASHBURN COLLEGE, TOPEKA, KANSAS.

BY PROF. J. T. LOVEWELL, DIRECTOR.

The usual summary by decades is given below.

TEMPERATURE OF THE AIR.	Mar. 20th to 31st.	April 1st to 10th.	April 10th to 20th.	Mean.
MIN. AND MAX. AVERAGES.				
Min	38.	31.	38.	. .
Max	75.	71.	75.	. .
Min. and Max	56.	51.	56.	. .
Range	35.	40.	37.	. .
TRI-DAILY OBSERVATIONS.				
7 a. m.	45.4	38.3	46.4	43.4
2 p. m.	63.8	58.6	58.2	60.2
9 p. m.	52.8	41.0	48.1	47.3
Mean	54.0	45.9	51.5	50.3
RELATIVE HUMIDITY.				
7 a. m.	.89	.86	.94	.90
2 p. m.	.71	.68	.90	.76
9 p. m.	.87	.74	.86	.82
Mean	.83	.76	.90	.83
PRESSURE AS OBSERVED.				
7 a. m.	28.842	28.912	28.856	28.870
2 p. m.	28.794	28.982	28.839	28.872
9 p. m.	28.909	28.065	28.874	28.947
Mean	28.848	28.987	28.860	28.896
MILES PER HOUR OF WIND.				
7 a. m.	14.5	18.1	24.2	18.6
2 p. m.	18.0	20.3	33.5	23.9
9 p. m.	12.6	14.4	21.7	16.2
Total miles	4254	3740	5266	13260
CLOUDING BY TENTHS.				
7 a. m.	5.5	3.9	7.8	5.7
2 p. m.	5.1	6.5	8.2	6.6
9 p. m.	5.2	3.4	8.2	5.6
RAIN.				
Inches	1.35	0.07	2.99	4.41

The past month has been cool and moist to a degree that has retarded the preparation for planting and the starting of fruit-buds. Flowering currant-bushes and apple and cherry-trees were beginning to blossom in Topeka about April 20th. At this date little corn is planted. The severe storm from the 17th to 20th, in which considerable snow fell, put back the preparation of corn-ground about one week. The rain and snow of this storm was fully three inches, during as many days. No damage was done to fruit by the cold weather.

BOOK NOTICES.

CREATION: By Arnold Guyot, LL.D. 12mo., pp. 136. Charles Scribners' Sons, New York, 1884. For sale by M. H. Dickinson, $1.50.

Professor Guyot, who died on February 8th, after a long and useful life, principally spent as a teacher of Natural Science and for many years as Professor of Geology and Physical Geography in the College of New Jersey, united to his devotion to science the utmost reverence for the teachings of Scripture. His remarkable exposition of the true meaning and import of the first chapter of Genesis is the most satisfactory that has ever been presented by a man of science. The views here set forth have frequently formed the subject of public lectures by Professor Guyot, and have attracted much attention. It was among the last wishes of the distinguished author that his attempt to show the accordance of the sacred narrative with the facts of Geological science should be given to the world in its final and perfected form, and to the preparation of such a work he devoted his latest energies. It is entitled "Creation" and is an exposition of the Biblical cosmogony in the light of modern science.

This subject was presented by him as early as 1840 in Neuchatel, Switzerland, and has been repeated in lectures and essays from time to time, ever since. Prof. J. D. Dana has quite fully endorsed the views of Professor Guyot in all the editions of his "Manual of Geology" from 1863 to 1882, and they have met with the approval of Christian scientists and thinkers of all countries.

He divides the Creation into two acts, one relating only to cosmic or universal work and the other to the specific work done on this earth only. He also harmonises the two Mosaic accounts of the creation by separating them into two periods. The first period begins with the first chapter of Genesis and ends with the third verse of the second chapter, and is complete in itself, "forming an organic whole which unfolds the history of the Creation of the material universe and of living things, including Man as a part of Nature."

The second period begins at the fourth verse of the second chapter and takes up "under another aspect the creation of man as the head of the family of humanity and specifically of the Jewish people."

Professor Guyot offers the following tableau as showing the symmetrical arrangement of the parts and the special work of each cosmogonic day: I. The Prologue. *a*. The Primordial Creation of Matter, *b*. The Primitive State of Matter. II. The Era of Matter. The first Cosmogonic Day. First Activity of Matter—Cosmic Light. Second Cosmogonic Day, Organization of the Heavens. Third Cosmogonic Day, *a*. Formation of the Earth, *b*. the plants. III. The Era of Life. Fourth Cosmogonic Day, the Solar Light. Fifth Cosmogonic Day, Creation of Lower Animals in Water and Air. Sixth Cosmogonic Day, *a* Creation of Higher Animals on land, *b*. Creation of Man. Seventh Cosmogonic Day, Conclusion: the Sabbath. The work of each day is taken up regularly and discussed in the light of modern science, most ably and interestingly, with the foling conclusions, as stated tabularly at the close of the volume:

ERA OF MATTER.

Introduction.

THE BIBLE.	SCIENCE.
In the beginning God created the Heavens and the Earth. 'nd the Earth was desolateness and 'mptiness; and darkness was upon ıe face of the deep.	Matter is not self-existent. Primitive state of matter. Gas indefinitely diffused.
First Day. And God sai l, Let Light be, and Light was. And God separated the light from the darkness.	*First Activity of Matter.* Gravity. Chemical Action. Concentration of diffused matter into one or more nebulæ, appearing as *luminous* spots in the *dark* space of Heaven.
Second Day. And God said, Let there be an expanse in the midst of the waters. And God made the expanse, and separated the waters under the expanse from the waters above the expanse.	*Division.* The primitive nebula is divided into smaller nebulous masses. Formation of the visible, lower, starry world.
Third Day. *a.* And God said, Let the water under the Heavens be gathered to one place and let the dry land appear. *b.* And God said, Let the Earth bring forth vegetation.	*Concentration.* The nebulous masses concentrate into stars. Our sun becomes a nebulous star. Formation of the mineral mass of the earth by chemical combination of the solid crust, the ocean, and atmosphere. The earth self-luminous; a sun. First appearance of land. Azoic rocks. First infusorial plants and protophytes.

ERA OF LIFE.

Fourth Day. And God said, let luminaries be in the expanse of the Heavens to separate the day from the night, and they shall be for signs, and for seasons, and for days, and for years.	Chemical actions subside. The earth loses its photosphere; sun and moon become visible. First *succession* of day and night, of seasons and years. Differences of climate begin. Archæan rocks. Protphytes. Protozoans.
Fifth Day. And God created the great stretched out sea monsters and all living creatures that creep, which the waters breed abundantly, and every winged bird.	Plants and animals appear successively in the order of their rank—marine animals, fishes, reptiles, and birds. First great display of land plants. Coal beds. Paleozoic and mesozoic ages.
Sixth Day. *a.* And God made the beasts of the earth, and the cattle and every creeping thing of the ground after its kind. *b.* And God created man in his image.	Predominance of mammals; the highest animals. The beasts of the earth, Carnivorous; the cattle, Herbivorous animals. Tertiary age. Creation of man. Quaternary age.
Seventh Day.—Sabbath. And God saw all he had made, and behold it was *very good.* And God rested on the seventh day.	No material creation. Introduction of the moral world. Age of man.

HISTORY OF THE DISCOVERY OF THE CIRCULATION OF THE BLOOD: By Henry C. Chapman, M. D. Octavo, pp. 56. P. Blakiston, Son & Co., Philadelphia, 1884. For sale by M. H. Dickinson.

This essay was delivered as a lecture at the Jefferson Medical College, December 10, 1883, concluding a course on the circulation, and constitutes, with but little modification, a chapter in a forthcoming work on Physiology by the author. It sets out with the statement that the discovery of the circulation was not made by Harvey alone, but that due credit must be given to Erasistratus, Galen, Servetus, Cæsalpinus, Malpighi, Aselli, Pecquett, Rudbeck, and Bartholinus, whose investigations extend over a period of 2,000 years, from the epoch of the Egyptian Ptolemies to the latter part of the 17th century. Harvey was doubtless the first who correctly described the course of the blood in making the entire circuit of the body, although the function of the capillaries in transferring the blood from the arteries to the veins was not discovered until after his death. To Malpighi is the honor of this important discovery due.

The story of the discovery of the circulation of the blood is told hastily, but accurately and attractively, from the days of the Greeks, who knew that the blood flowed in the veins, but supposed that the arteries, from their being found empty in *post mortem* examination, carried only air. Even Aristotle could only teach that the veins communicated with the heart, that vessels passed from the heart to the lungs and that the heart and veins were filled with blood.

Galen, who learned his anatomy in Egypt, was the first to demonstrate that the arteries as well as the veins carried blood, which was of course the golden link in the chain leading to the discovery of the circulation. Servetus was the first to point out the aëration of the blood carried to the lungs by the pulmonary artery. Several pages are devoted to an account of his life and discoveries.

Harvey in 1628 not only the first to describe the entire circulation correctly but also to give the first accurate account of the movements of the heart and of its auricles and ventricles. To Malpighi, in 1661, science is indebted for the discovery of the capillaries connecting the veins and arteries, thus completing the discovery of the complete circulation of the blood.

THE ELEMENTS OF POLITICAL ECONOMY: By Emile De Laveleye. 12mo., pp. 288. G. P. Putnam's Sons, New York. For sale by M. H. Dickinson, $1.50.

This work is designed by the author as a manual of instruction, and with that object in view he deviates from the usual course of writers upon the subject and comprises within his scheme, as correlatives, philosophy, moral science, the traditions of the past, history and geography. He says in explanation of this that "Geography describes the positions of Nations and History relates their annals. No advantage can be gained from the lessons which either offers without the aid of political economy. At the present day it is allowed that the most important part of history is that which traces the progress of humanity

in comfort and liberty. To understand this advance from prehistoric barbarism to the prodigious development of wealth which marks our own epoch, a knowledge of economy is indispensable." Carrying out this idea he quotes freely from recognized authorities, and with the enunciation of each principle of political economy he has given illustrative examples or maxims to enforce attention to it.

In speaking of the importance of a knowledge of this subject he says, "As citizens of a free country we need the training of men. From our earliest years the state claims our attention; even in childhood political economy ought to make us see that freedom leads nations to prosperity, while despotism leads them to decay. Need more be urged to prove the necessity of spreading economic knowledge?" He then points out that the greater part of the evils from which societies suffer spring from their ignorance of this subject. National rivalries, restrictions on trade, wars of tariffs, improvidence of the working classes, antagonism between workmen and employers, over-speculation, ill-directed charities, excessive and ill-assessed taxes, etc., all are indicated as so many causes of misery, springing from economic errors.

The treatise is the work of an able and experienced man, and while it may not in every particular apply directly to our national conditions, it will be found valuable, reliable and suggestive to all students of the general subject while the introduction and supplemental chapter by Prof. Taussig, of Harvard College, may be regarded as strictly applicable to our own country.

OTHER PUBLICATIONS RECEIVED.

The Sewerage of Kansas City, by Robt. Moore, C. E., with Discussion and Reply by O. Chanute, C. E., pp. 20. Notes on Glaciers in Alaska and Favorable Influence of Climate on Vegetation in Alaska, by Thomas Meehan, pp. 8. Notes on the Literature of Explosives, No. VI, by Prof. Chas E. Munroe, U. S. N. A., pp. 29. Quarterly Report of the Kansas State Board of Agriculture, March 31, 1884, Wm. Sims, Secretary, pp. 94. Speech of General Wm. H. Powell at the Banquet of the Press Association of Southern Illinois, upon "Our Industries." *St. Louis Druggist*, April 26, 1884, weekly, $2.00. Second Annual Report of the Health Department of Kansas City for the calendar year 1883, by Dr. John Fee, pp. 60. Mound-Builders Works near Newark, Ohio, by Isaac Smucker, pp. 20. *The Builder and Manufacturer*, Pittsburgh, Pa., monthly, $2.00 per annum. Report of the Professor of Agriculture, Kansas State Agricultural College. Experiments, 1883, by Prof. E. M. Shelton, pp. 48. *Random Notes*, Volume I, No. 3, Southwick & Jencks, Providence, R. I. Fifteenth Annual Report of the American Museum of Natural History, New York, March, 1884, pp. 36. Bulletin of the Philosophical Society of Washington, Vol. VI, for 1883, pp. 168. Methods of Historical Study, by Herbert B. Adams, Ph.D., Johns Hopkins University, pp. 136. Bulletin of the American Museum of Natural History, February, 1884, Vol. I, No. 5, pp. 40.

SCIENTIFIC MISCELLANY.

A MISSOURI RIVER COMMISSION.

Mr. Clardy's favorable report on the Graves bill to create a Missouri River Improvement Commission is one of very great importance, and is substantially as follows:

The object of the bill is to establish a Missouri River Commission, composed of two officers of the Engineer Corps, one of the Coast and Geodetic survey and two civilians, to superintend the expenditure of money appropriated by Congress for the improvement of the navigation of the Missouri River, and to make the necessary investigations and study of that river for the purpose of devising the most effective and economical method of using the annual appropriations made for this water-way.

To properly appreciate the importance of legislation, whose object is the keeping in repair this national highway, it may be well to consider that this river has a length of over 3,000 miles, and has been navigated its entire length from its mouth to Fort Benton, in Montana.

The States of Missouri, Kansas, Iowa, Nebraska, and the Territories of Montana and Dakota, are drained by its waters, while Colorado, Wyoming and New Mexico are to be considered as greatly interested in and affected by the commercial problems involved in the improvement of this river.

The census of 1880 shows that Kansas, Nebraska and Montana and such portions of Missouri, Iowa and Dakota as may be fairly embraced in the Missouri River Valley contain 260,000,000 acres, 3,500,000 people, whose assessed wealth aggregates $1,250,000,000, of which $900,000,000 consist of landed property and the remainder is principally live stock, there being near 5,000,000 head of cattle, 1,500,000 horses, 4,700,000 hogs and over 2,000,000 head of sheep. It produced in 1879 over 60,000,000 bushels of wheat, over 400,000,000 bushels of corn, 53,000,000 bushels of oats, 1,800,000 bushels of rye, and 4,300,000 bushels of barley. During 1881, the Government collected in this district internal revenue alone amounting to $7,727,000. Could the census be shown for the year 1883 the foregoing estimates would be surprisingly magnified.

That this great water-way should be put in the best navigable condition is in accordance with the rules of political economy as well as common sense, it being located in a region so fertile and productive of all that administers to the wants of teeming millions. It is located where it is most needed and where it can perform the greatest service in the shape of transportation. With the great natural advantages possessed by this water-way it should be the main dependence for the bulky freights of an agricultural valley. But it is the channel of commerce least

in use. At first the railroads were considered merely tributary to the water lines; but now the railroads have gained in prestige until the river has lost its commerce and has become merely tributary to the railroads.

The people of this valley are beginning to appreciate the fact that it is a costly luxury to ignore the plans of nature, and now, more than ever before, they are considering the international features of this great river.

The language of the Supreme Court of the United States in the case of Daniel Ball, 10 Wallace, 557, fitly applies to this river. The court said: "Those rivers must be regarded as public, navigable rivers in law which are navigable in fact. And they are navigable in fact when they are susceptible of being used in their ordinary condition as highways for commerce over which trade and travel are or may be conducted in the customary modes of trade and travel on water. And they constitute navigable waters of the United States, within the meaning of the acts of Congress, in contradistinction to the navigable waters of the States, when they form in their ordinary condition, by themselves or by uniting with other waters, a continued highway over which commerce is or may be carried on with other States or foreign countries in the customary modes in which such commerce is conducted by water.

This is the legal aspect in which such rivers as the Missouri are viewed by our highest supreme judiciary.

The case is well presented in its scientific and economic aspect in the following extracts taken from the letter of the Secretary of War of February 17, 1881, "in relation to the improvement of the Missouri River," transmitting to the House of Representatives a report from Major Suter of the Engineer Corps, upon the improvement of this river, as follows:

"The importance of the subject can hardly be overestimated, as this river is the longest of any in the United States, and is with the exception of the Ohio, the largest tributary of the Mississippi. Its channel length from its sources in the Rocky Mountains to its junction with the Mississippi near St. Louis, is probably something over 3,000 miles, and it brings forward the drainage of an area of 572,672 square miles. It is navigable for nearly its whole length, for the portion above the Great Falls, near Fort Benton, is already provided with several small steamers. Its tributaries, though often of great length, are not of great size, and are rarely navigable in their present condition.

The country through which the Missouri flows is mostly one of a small rainfall, so that its really large discharge is due to the great area of its drainage basin and the mountain snows and ice near its headwaters. Its most salient and striking features are the remarkable impetuosity of its current, and its slope, which is considerable for so large a stream. The rapidity of the current and the general instability of its banks and bed give rise to the excessive turbidity of its waters, which have earned for it the title of the "Big Muddy." It is, in fact, the great silt-carrier of the country, and the enormous mass of sediment which it brings forward forms the great bulk of that received by the Mississippi from its tributaries. Its influence upon the main river is most marked; indeed it is its proto-

type in its main physical features, and, from the navigation point of view, at least, it may be said to have a marked controlling effect upon the main trunk stream. The subject of its improvements, therefore, is not only of local interest, but is of the greatest general importance, now that the improvement of the Mississippi is receiving serious consideration."

"And upon page ten of said Report the following is found: "Work already done furnishes me the means of approximately estimating the cost of this improvement, which, if carried out on a large scale, and with liberal appropriations, will not probably exceed $10,000 per mile. This would put one cost for the whole 800 miles under consideration at $8,000,000, and from Kansas City to the mouth of the river at $3,750,000. See ex. document No. 92, third session, Forty-sixth congress.

The single state of New York has expended over $80,000,000 in the construction and improvement of 1,300 miles of canal within her borders. Whereas, by this report to the War Department the internal revenue collected for a single year from the district directly interested in the improvement of this river would defray the expenditure in making this national highway permanently navigable throughout its entire length, and one-half that amount would do the work from Kansas City to its mouth.

This report concludes with the following language:—

"The benefits attendant on such an improvement can hardly be over-estimated. With a guarantee that at lowest navigable stages a safe and permanent channel, having nowhere a less depth than twelve feet, will be available, boats and barges as large as any now used on the Lower Mississippi could be built and safely navigated. They could also be provided with heavy power and staunch hulls, such as would be needed to cope with the strong current of the Missouri River. Snags, which now are great and ever-present obstructions, would be to a great extent swept away by the deep scour of floods, and the supply of new ones would be materially reduced by the general prevention of bank erosion. The amount of sediment carried into the Missouri would be proportionately reduced by the same work, and very substantial benefit be thus directly received by that river. The whole valley of the Missouri is extremely fertile, and if reclaimed, as it would be by this improvement, would soon be all under cultivation, and the amount of grain which would seek the river transportation would be enormous. The estimate for the whole work thus sketched out is $8,000,000, which could, with due regard to economy, be expended at the rate of $1,000,000 per annum. At this rate the whole improvement would require eight years for completion, or from Kansas City to the mouth four years, with proportionate increase of time if the annual appropriations should be smaller than here indicated."

For the ensuing fiscal year the Secretary of War submits the following estimate to be appropriated:—

For the improvement of the navigation of the Missouri River, $1,400,000;

for snagging the same, $188,000; for continuing survey on same, $50,000; and for the improvement of the Yellowstone tributary, $100,000.

The magnitude of the interests involved, and the peculiar characteristics of the river, differing as it does from any other in the United States, in the judgment of your committee render the appointment of a Missouri River commission, as contemplated in the bill, a necessity, and we, therefore, report the same with a recommendation that it do pass.

We further recommend that the same be so amended as to have three members of the army corps of engineers and two civilians compose said commission, instead of two members of the army corps of engineers and one of the coast and geodetic survey and two civilians, as provided by the bill.—*Kansas City Times.*

PROPOSED NEW ROUTE TO EUROPE.

King Leopold, of the Belgians, it is reported, is engaged in an enterprise having for its object the founding of a new route for ocean travel between America and the old world. The route selected will, it is said, be direct from New York to about the 40th parallel, and along that to the Portugese coast, with the European entry at Lisbon or Cadiz. The Portugese and Spanish Governments have both been sounded upon the subject, and will, it is understood, do all in their power to improve direct railway communication from the selected port to Paris, and to improve the harbor facilities at the designated port of entry. The navigators and engineers who have given the subject special consideration approve the project thoroughly and pronounce the new route the best possible between America and Europe. The 40th parallel is comparatively free from the long storms besetting the present ocean courses, and icebergs rarely get so far south. From New York to Liverpool steamers must average a change of nearly 14° latitude from south to north, and, with the exception of about five months out of the twelve, have to contend against weather and seas practically Arctic in fitfulness and dangers. This confines first-class travel to the summer months and adds enormously to the cost of shipping and insurance in the winter months. The Belgian engineers pronounce the port of Liverpool the most unnatural and difficult of approach of all the great ports of the world, and declare it to be their belief that because of this, and of the long journey from Queenstown to the Mersey, Liverpool must soon cease to occupy its present importance as the principal port of European entry. The solution of the ocean problem, these engineers declare, will be only found in a route with an Atlantic port at the eastern terminus, which must be as nearly as possible on a line straight east from New York, and in Portugal or Spain.

The principal advantages of the 40th parallel route are claimed to be the following: First, a clear ocean passage below the line of icebergs and winter storms, from port to port, enabling steamers to run with full power the whole course: second, comparatively equable weather the whole year through, enabling

steamers to keep up the average and regularity of their trips in winter as well as in summer, and thus increase the number of round trips per annum from the present average of twenty to thirty; third, a temperate parallel, which will render passenger travel comparatively safe and pleasant the year round, and enormously increase it; fourth, entire avoidance of the dangers from icebergs and rough seas of the northern parallels, and a consequent prolongation of the life of ships and decrease in the costs of insurance. Besides the above advantages the new route, the Belgians claim, will be from 150 to 300 miles shorter than the route to Liverpool, and will have the Canary Islands as a sort of halfway station if necessary.

THE GREELY RELIEF EXPEDITION.

The advance vessel of the Greely Relief Expedition, the Bear, has sailed from New York for the polar regions. The other two vessels, the Alert and the Thetis, will quickly follow. These are the strongest and best equipped steamers that ever set out to battle with the ice. The prayers of millions of people in both continents will follow them on their mission of mercy. If Lieut. Greely and his party are still at Lady Franklin bay the relief vessels are expected to go there and bring them home; if they have started southward in the hope of reaching one of the supply depots which they established on their northern voyage on the coast of Grinnell Land and at Littleton Island, the relief party must search for them. Lieut. Greely's instructions were to abandon his station not later than September 1, 1883, should no relief ship reach him. If these instructions have been carried out there is no telling at what port the party may be waiting to be rescued. The relief ships are expected either to find them or to ascertain their fate.

The twenty-nine men who composed the Greely party are officers and enlisted men of the regular army detailed for duty in the signal corps. They were sent to Lady Franklin bay to establish and maintain a meteorological station for two years, in accordance with a plan agreed upon by the International Polar Commission. Nothing has been heard of Lieut. Greely since the day the Proteus left Lady Franklin Bay, in the summer of 1880. Two relief expeditions have been sent after the Greely party without avail, as the world knows. It is sincerely to be hoped that the third and last one may be successful.—*National Republican.*

"TAKING AIM"—TWO EYES OR ONE?

Quite a lively discussion is said to be taking place in England as to whether a marksman generally takes aim with both eyes or one in rifle shooting. Those who consider that one eye alone is used endeavor to prove their case thus:

Hold, they say, a ruler before the right eye in such a position that when the left eye is closed it covers the object; now shut the right eye, and see in which direction the ruler points; it will be found to be many inches, or feet, or yards away to the right, according to the distance of the object. It is therefore obvious, so the argument runs, that a man fixes the object, bird, or target, as the case may be, with his right eye, and neglects the image formed on his left retina altogether. The difference of opinion upon the subject depends, according to the *Lancet*, on the different practice of aiming adopted by different sportsmen. If a man shoots slowly, accommodates his eye to the sight or sights on the barrel of his gun, and then relaxes his accommodation for the distant object, and still more if he alternately exerts and relaxes his accommodation, for which there is ample time in target or any other deliberate shooting, then undoubtedly he uses one eye, and, of course, usually the right eye, alone. But the act of accommodation is a slow process, it requires nearly, if not quite, a second, and in ordinary bird-fowling the sportsman has no time for this. The more practiced he is the less he attends to his barrel and his sights. He first fixes the object with both eyes, and then points the barrel at the precise elevation and in the direction which long experience has taught him will be effective when the gun is discharged. He adapts his eyes for the distant object, and the rest is mechanical. Corroborative evidence that this view is correct is afforded by the fact that the bowler at cricket never closes one eye or troubles himself about any line. He simply fixes the wicket or the precise spot in front of the wicket on which he desires to pitch the ball, and leaves the rest to the co-ordinating nervous centers. The billiard player, again, in the vast majority of cases uses both eyes, and fixes alternately the near and the distant ball with both eyes. Therefore, if a man uses his sights and attends to his barrel as well as to the object, he employs one eye only, neglecting the impressions derived from the other. If, however, as is customary with experienced sportsmen, he takes no thought of his gun and fixes the distant object, then, undoubtedly, unless he has some defect of vision, he uses both his eye, the visual lines of which at thirty yards are almost parallel to each other.—*Scientific American.*

RECENTLY PATENTED IMPROVEMENTS.

J. C. HIGDON, M. E., KANSAS CITY, MO.

LIFE GUARD FOR FREIGHT CARS.—This invention consists of a platform, or plank, of suitable width and of a length somewhat shorter than the width of the freight car-end to which it is applied, and its object is to prevent the falling of the train-men from and between the cars to the track below, and the loss of life that unerringly attends such casualties.

The platform is secured at any desired height to the end of a car, through the medium of two or more supporting brackets upon and to which the platform is loosely connected by metal sliding-bearings.

These sliding-bearings are bolted to the underside of the platform and are forcibly kept at the outer extremity of the supporting-brackets by means of springs coiled thereon. Now, should two cars that are fitted with the platform, be brought together suddenly, as for instance, in a slight collision: the front edges of the safety platforms come in contact first, then, as the movement continues the springs are compressed until the limit is reached by contact of the dead-wood blocks on each car.

Should the cars be of different heights, the platforms will readily pass each other without compressing the springs, and the apparatus adapts itself easily to all the different movements of the cars, for even when the draw-bars are fully distended there is not sufficient space between the two platforms to permit the passage of a falling brakeman to wheels below.

No matter how slippery the car-top, or how dark the night, if a brake-wheel is wrenched off by a brakeman he cannot fall under the wheels, the Life-Guards will prevent it; and although he may slide off the platforms to the side of the track, his injuries will be comparatively slight. The inventor is Mr. Benjamin L. Ferris, of this city.

MANUFACTURE OF CORRUGATED METAL-SHEETS AND SECURING THE SAME, WITHOUT NAILS, TO BUILDINGS.—Hook-shaped fastenings are used instead of nails and stamped depressions along the edge of the sheets are adapted to fit snugly over the fastening-hooks that are previously attached to the timbers of a building.

The hooks for the ends of the sheets are simply pieces of wrought-iron that are, say, three inches in length, one-half inch in width and an eighth of an inch in thickness, having one end bent to form a smaller hook and the opposite extremity provided with openings for attaching them to the timbers by means of wood-screws.

The sheets of metal are prepared by running them through a corrugating machine; this machine has suitable dies upon the rollers which form the depressions along the corrugated edge of the sheet as it travels between them. In applying the roofing to a building, a sufficient number of the straight-hooks are attached to the timbers at such a distance apart as will correspond to every other longitudinal depression in a previously laid sheet, then an over-lapping sheet having the before mentioned indentations along its lower edge, is placed in such a position that the indentures fit within the short hooked-ends of the fastenings. As before stated, the indentations are to make room for the fasteners so that the overlapping sheets will not be held away from the one previously laid, and their overlapping straight edges are secured by means of substantially the same form of fastenings as are used for the corrugated edges, the only difference being that the body of the straight-edged fasteners are curved to fit the concavities of the sheet.

These fastenings for the straight-edges are placed at suitable distances apart and in applying them a line of sheets having been run up the building, the

fasteners for the straight-edges are placed so that their curved ends fit across the outside convex edge of the sheets, and upon applying another course of roofing the contiguous edges lap over, and are held in position by the short hooks upon the curved end of the side-fastenings.

This method of applying corrugated roofing, etc., dispenses entirely with leaky nail-holes and nails, and in addition to other advantages over the old rigid nailing process, the sheets are free to expand or contract with the varying temperatures in which they may be placed. Recently patented by Mr. John Smith, of this city.

EDITORIAL NOTES.

MAJOR F. F. HILDER, of St. Louis, having been appointed by the Governor of this State commissioner to the "World's Industrial and Cotton Centennial Exposition," which will be opened at New Orleans the first Monday in December, 1884, calls attention to the importance of having the vast resources of Missouri in minerals, soils, manufactures, and agricultural products fully represented. The State having made no appropriation for the purpose, he appeals to its patriotic citizens to contribute funds to cover the necessary expenses.

THE Social Science Club of Kansas and Western Missouri meets in this city Thursday and Friday, May 8th and 9th, at the Second Presbyterian Church. It is made up of the best educated and most thoughtful ladies of this region, and the papers to be read at its sessions will be of engrossing interest.

To give an idea of the amount of passenger business done at the Union Depot in this city, we select a few items from the report of the Treasurer of the Union Depot Company for six years, ending December 31, 1883: Cash received for tickets in 1878, $474,591.26; for 1883, $1,161,202.26, an increase in six years of $786,611.30. The total cash receipts for the whole time were $5,763,572.47, to which is to be added the value of tickets exchanged, $413,061.63, making a grand total of $6,176,634.10.

JANSEN, MCCLURG & Co. have published a series of very useful Tables for the Determination, Description, and Classification of Minerals, by James C. Foye, A. M., Ph. D., Professor in Lawrence University. Second edition, revised and enlarged. Mineral species are determined by tables I. and II; table III gives the crystalline structure, fracture, specific gravity, hardness, luster, streak, color, action of acids, and blowpipe reactions of each species; table IV classifies the species according to the 5th Ed. of Dana's System of Mineralogy; table V classifies by basic elements and ores. The Appendix enables one to distinguish between some of the closely allied species and varieties. Scales of hardness and fusibility, systems of crystallization and all the blowpipe reactions referred to in the work are fully described in the introduction. Cloth, 12mo., 85 pages; price $1.00. It is a very complete work and offered at a very low price.

ON Monday, the 21st ult., snow fell in this city continuously for twelve hours, viz.: from 6 A. M. to 6 P. M., amounting to at least six inches, though as it melted nearly as fast as it fell it could not be measured. We put this on record as a phenomenal day.

THE U. S. Signal Office has published four maps presenting the specific meteorological features of the tornadoes of March 11th, 1884, and showing the general relation between areas of barometric minima and tornado centres. This advance work is to be followed by a full report of a more extended investigation.

MRS. J. LAWRENCE SMITH, of Louisville, Ky., the widow of the late Professor J. Lawrence Smith, has donated $8,000 to the National Academy of Science, the income from which is to be used for the encouragement of scientific investigation.

PROF. JEAN BAPTISTE DUMAS died at Paris on April 10, at the age of eighty-four. He was born in Alais, July 14, 1800. Under the patronage of De Candolle, at Geneva, he early acquired considerable proficiency as a botanist and chemist. In 1821 he went to Paris, married the daughter of Alexander Brongriart, and was professor of chemistry in the polytechnic school, in the faculty of science, and in the school of medicine. In 1868 he was elected perpetual secretary of the academy, and in 1869 the London Society of Chemistry gave him the Faraday medal. He was the author of many standard scientific works.

THE results of a recent investigation by the British Medical Association gives color to the theory that consumption is an infectious disease. Circulars were sent out to over 1,000 physicians, asking for experiences and opinions in that connection, and of the number who replied a decided majority expressed a belief in the affirmative.

THE Canadian weather-prophet, Wiggins, claims that the recent storms and earthquakes in England were a fair fulfillment of his March predictions. The Professor believes that there is serious probability that the earthquake in England will return with increased violence about the 20th of this month.

ON Tuesday, September 2d, 1884, the grand International Electrical Exhibition will open at Philadelphia, under the auspices of the Franklin Institute for the promotion of the mechanical arts, and continue until October 11th, 1884. For information apply to Prof. Wm. H. Wahl, Secretary.

THE Washington monument reached the height of 410 feet on the 22d ult. The total height of the shaft will be 555 feet, which will make it the highest monument in the world. This leaves 145 feet yet to be added, fifty-five of which will be a marble roof of pyramidal shape.

A great well of natural gas was struck at Wellsburg, West Virginia, twelve miles north of Wheeling, on the 24th of April, at a depth of 1,287 feet.

DURING the week from June 28 to July 5, inclusive, it is proposed to institute a summer school of geology at the Delaware Water Gap, Monroe Co., Pa.—a locality peculiarly suited for geological instruction, under management of Prof. H. Carvill Lewis. Excursions to various points of geological interest will be taken every day, and opportunity given for studying in detail the various formations in place of their influence upon the topography. Each evening an illustrated lecture will be given upon the geology of the region.

ONE of the best American science magazines that comes to our table is the KANSAS CITY REVIEW OF SCIENCE AND INDUSTRY. It comprises original articles by the best writers, and selections from the best periodicals of this country and Europe on all scientific subjects, and is deserving of the patronage of all intelligent and enterprising educators East and West.—*Boston Journal of Education.*

THE Normal School *Advocate* says of the REVIEW, "Every teacher should be a subscriber to this truly excellent periodical."

WE are indebted to the editor, Theo. S. Case, for a copy of his sterling periodical, which is a credit to the scientific taste and culture of the West. It fills an unfilled corner of the periodical literature of the West and should have a place upon the table of every lover of science.—*Council Grove Republican.*

THE main building of the World's Industrial and Cotton Centennial Exposition, at New Orleans, now being constructed, is in many respects the most remarkable edifice ever erected in this country. It is 1,378 feet long by 905 feet wide, covering thirty-three acres, or eleven acres more than the main building of the Philadelphia Centennial Exposition of 1876. There are 1,656,300 square feet of floor space, including the gallery.

The building will be sixty feet high with a tower 115 feet high, and the architect has been unusually fortunate in rendering the exterion exceedingly unique and attractive. To light it with incandescent lamps will require 15,000 lights and 1,800 horse-power. To light with the arc system will require 700 lamps and 700 horse-power to operate the dynamo. The total steam required for lighting and for machinery hall will be at least 3,000 horse-power. In this estimate is included the power for five arc lights of 36,000 candle-power each, which will light the grounds.

THE Edinburgh University celebrated its 300th anniversary last month. Scotland, England and the world owe very much of the best thought of the last three hundred years to this institution, and some of the strongest men of the age, have issued from this old and honored seat of learning. Mr. Lowell had a worthy part in the celebration, and was introduced by Sir Stafford Northcote as "one of the greatest literary ornaments" of our own time.

IT is now officially announced that the tunnel under the Mersey, which is to connect the cities of Birkenhead and Liverpool, will be formally opened for ordinary traffic on the 14th of next month. The last remnants of the wall between the two ends of the tunnel were blown out on the 26th of April.

ITEMS FROM PERIODICALS.

Subscribers to the REVIEW *can be furnished through this office with all the best magazines of this Country and Europe, at a discount of from* 15 *to* 20 *per cent off the retail price.*

To any person remitting to us the annual subscription price of any three of the prominent literary or scientific magazines of the United States, we will promptly furnish the same, and the KANSAS CITY REVIEW, *besides, without additional cost, for one year.*

THE best articles in the May *Popular Science Monthly* are: The Beaver and His Works, by Dr. G. A. Stockwell (Illustrated); The Progress of the Working-Classes in the Last Half-Century, by Robert Giffen, LL. D.; The Milk in the Cocoa-nut, by Grant Allen; Longevity of Astronomers, by Albert B. M. Lancaster; How Flies Hang On, by Dr. J. E. Rombouts (Illustrated); Where Did Life Begin? by G. Hilton Scribner; Christian Agnosticism, by the Rev. Canon Curteis; The Beginnings of Metallurgy, by Dr. E. Reyer; The Mortality of Happiness, by Thomas Foster; Sketch of Mary Somerville, (with portrait), followed by the usual Correspondence, Editor's Table, Literary Notices, Popular Miscellany, and Notes.

Immigration continues to be one of the great economic questions of this country, and it involves a political problem of the highest importance, that of naturalization. Our naturalization laws are defective in many respects, and the demand for their revision will no doubt acquire added force from the publication of an article by Justice William Strong upon that subject in the *North American Review* for May. In the same number of the *Review*, Edwin P. Whipple offers a candid judgment of Matthew Arnold, as a thinker and as a man of letters. Richard A. Proctor, under the title of "A Zone

of Worlds," writes of the vast multitude of the pigmy kindred of the earth, known as the asteroids. In "The Railway and the State," Gerrit L. Lansing essays to prove that the multiplication and extension of railroad lines, and the establishment of low rates of transportation, are hindered, rather than helped by governmental interference. Prof. Henry F. Osborn, of Princeton College, has a highly interesting article on "Illusions of Memory." Helen Hendrick Johnson contributes an essay on "The meaning of Song." Finally, there is a joint discussion of "Workingmen's Grievances," by William Godwin Moody and Prof. J. Laurence Laughlin, of Harvard University.

We have had occasion before to refer to the *Western Art of America*, a musical periodical edited by Mr. Emil Seifert. It has now reached its fourth month and secured a firm footing among the periodicals of the city. To those of our readers who do not see it we can recommend it as a reliable and critical compendium of passing events in musical and art matters, edited by a competent critic and skillful musician. We know of no similar paper in the West and it should be well supported.

The Scientific Basis of Morals, and other essays, by William Kingdom Clifford, F. R. S.; price 15 cents, post free. J. Fitzgerald, publisher, 20 Lafayette Place, New York. This collection of essays upon Ethics forms No. 55 of the *Humboldt Library of Popular Science*. Besides the essay named in the title, it contains three others, namely, "Right and Wrong: the Scientific Ground of their Distinction;" "The Ethics of Belief;" and "The Ethics of Religion."

Harper's Magazine for May concludes the sixty-eighth volume of that now venerable, but never aged periodical. The cosmopolitan character of our American magazines has never been better illustrated than in the announcements of this number. Certainly American topics, authors, and artists are thoroughly represented, but there are also papers on English, French, and German subjects, written by Englishmen, Frenchmen, and Germans, and illustrated by English and French artists. William Black, William Sharp, Alfred Parsons, A. F. Jacassy, and Dr. Moritz Busch are among the contributors in question. Yet *Harper's* is commonly accounted the most American of our magazines.

In the *Atlantic Monthly* for May Richard Grant White contributes the first of two articles entitled "The Anatomizing of William Shakespeare," a very acute and interesting study of the facts of Shakespeare's life and writings, dissipating some of the idolatrous illusions which some extreme Shakespeare worshipers have created. Henry James continues his French studies of travel. Prof. E. P. Evans has an article on "Linguistic Palæontology" which will be found of deep interest to all intelligent readers. Articles of public national interest are: "The Silver Danger," by J. Lawrence Loughlin; and "The Progress of Nationalism," by Edward Stanwood. The poems of the number are by T. B. Aldrich, H. H., and Edith M. Thomas. Several important books are reviewed, and the Contributors' Club completes a thoroughly interesting and attractive number of this sterling magazine. Houghton, Mifflin & Co., Boston. Subscription $4.00.

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T. S. CASE, Ed. "Review."